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ERRATA

Vol. 10, No. 1, January 1941: Note entitled "Production of Fruit-bodies of *Agariceus polyporus* Berk. in Artificial Culture", page 26, 2nd column in the heading of the note, *for* "*Agariceus polyporus* Berk." *read* "*Polyporus agariceus* Berk."; line 20 of the same note, *for* "Polyporus culture" *read* "Polysporus culture".

Vol. 10, No. 2, February 1941: With reference to figures illustrating Professor B. Sahni's article on "Yaudheya Coin Moulds from Sunet, near Ludhiana in the Sutlej Valley", pages 65–67, the correct numbering is as follows:—

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3	4	7	8
5	6	9	10
10*a*	11	11*a*	12

Vol. 10, No. 3, March 1941: P. 173, Note on "Chromatin Bridges in the Root Tip of Groundnut", *insert* the following under Fig. 1:—"The fragment found along with the chromatin bridge".

Vol. 10, No. 4, April 1941: 1. Contribution entitled "Cinchona Cultivation in India", page 223, para 2, line 8, *for* "21,00 lbs." read "210,000 lbs." 2. Note entitled "Modified Equations for Adsorption and Base-Exchange in Soils", page 203, Table II, column 4, *for* $x = \frac{BU}{1+C}$, *read* $x = \frac{BI}{1+C}$. 3. Table II, column 5, the last but one value, *for* 1·123 *read* 1·213.

Vol. 10, No. 11, November 1941: Note entitled "Industrial Research Fund", page 483, second column, line 14, *for* "prominent" *read* "permanent".

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SUPPLEMENT: CRYSTALS AND PHOTONS BY SIR C.V. RAMAN

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CURRENT SCIENCE

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SCIENCE AND INDUSTRY*

BY

SIR ARDESHIR DALAL

I FEEL that the authorities of the Indian Science Congress Association have made a very bold departure in electing a layman to the honour of the Presidentship for the year and, deeply conscious as I am of the honour, I confess to a feeling of diffidence in occupying a post which has been adorned by so many distinguished scientists before me. If my address falls short of the standard set by my predecessors, the responsibility of it should in part be borne by those who have elected me. The only reason for their choice, as far as I can see, lies in the fact that I may lay some claims to be an industrialist. So close and intimate is the relationship between science and industry and so strongly is that fact being brought home to us in these days that the Association felt perhaps that they would like to have the views of an industrialist on the relationship of science to industry with particular reference to the practical problems which have arisen in India since the beginning of the war. A substantial part of the export trade of India has been lost since the war. Science can help in the utilization within the country itself of some of the raw materials which used to be exported. Researches are being conducted for instance on the use in India for lubrication purposes of some of the oil seeds of which the export has dwindled down and the surplus of which is likely to create serious economic trouble for the cultivator. Even a more acute problem is the stoppage of the import of many commodities essential for the economic life of the country, such as machinery, chemicals, etc. It is imperative that India should make herself self-sufficient with regard to such materials as are vital to the maintenance of her economic and industrial life so that the situation which had arisen during the last War and which has arisen once again may never recur. It is here that science can be of the greatest assistance to industry. Research has been described as the mother of industry and while some of the older and more traditional industries may have originated without the aid of science, it cannot be denied that all industries to-day depend upon science and research not only for their progress and improvement but also for their survival. Sad experience has proved to us beyond all doubt that, under modern conditions, no nation, however peacefully inclined, can expect even to live an independent existence unless it is highly industrialized. It is the industrial potential that is convertible into the war potential and the country that has

* Presidential Address delivered at the Indian Science Congress, Benares, 1941.

the highest industrial potential and is prepared to convert it in the shortest time into war potential that stands the best chance in modern warfare. As we have seen, it is not man power that counts in the highly mechanized warfare of the present day, but planes, tanks, guns, ships and the factories, plants and workshops behind them. The lesson for India is plain and she can only neglect it at her peril. It is no longer the question of a balanced economy or of mere material progress. It is necessary for India's very existence that she should be highly industrialized.

This lesson was first taught during the last World War. Owing to its superior scientific organization and equipment Germany was able to withstand the Allies much longer than she could otherwise have done. At the beginning of that War, England found that she was deficient in many forms of optical glasses, dyestuffs, chemicals and other necessities for the conduct of modern warfare. She set herself to remedy these drawbacks. A very important dye industry was created and the whole of the scientific and research talent of the country was organized by the creation of the Department of Scientific and Industrial Research. It is not necessary for me to enter into the details of the organization and working of the D.S.I.R. with which many of you must be familiar. An interesting feature of the organization, however, to which the attention of the authorities in India needs to be drawn is that the administrative organization of the D.S.I.R. is entirely composed of technical men, while the Advisory Council, which guides and controls its activities, is mainly composed of distinguished scientists with the addition of two or three well-known industrialists and business men. The words of Lord Rutherford to the Twenty-fifth Indian Science Congress, though frequently quoted since then, will bear repetition as they have an important bearing on the policy of the Government of India towards the recently created Board of Scientific and Industrial Research. He said:

'In Great Britain, the responsibility for planning the programmes of research, even when the cost is borne directly by the Government, rests with research councils or committees who are not themselves State servants but distinguished representatives of pure science and industry. It is to be hoped that if any comparable organization is developed in India, there will be a proper representation of scientific men from the universities and corresponding institutions and also of the industries directly concerned. It is of the highest importance that the detailed planning of research should be left entirely in the hands of those who have the requisite specialized knowledge of the problems which require attack. In the British organizations there is no political atmosphere, but of course the responsibility for allocating the necessary funds ultimately rests with the Government.'

There has been a tendency in the past in India for scientific and research work to be monopolized by Government Departments and although valuable results have been obtained, *e.g.*, by the Survey of India, the Geological Survey, the Botanical Survey and in the investigation of tropical diseases, it is very necessary that organized industrial research should as far as possible be left to scientists and industrialists although of course Government has to see that the grants it makes are properly utilized.

Board of Scientific and Industrial Research

Industrial research was organized on a country-wide basis in America as well as in several countries of the British Empire following the lessons of the last War. In India also the War revealed the helplessness of the country. The transport service was disorganized owing to lack of railway material; supplies of dyes, important chemicals and many important medicines were almost completely stopped and prices of textiles shot up so high as to be beyond the means of poor people. In 1915 the Government of India addressed the Secretary of State as follows:—

'After the war India will consider herself entitled to demand the utmost help which the Government can afford to enable her to take a place, so far as circumstances permit, as a manufacturing country.'

This policy was accepted by the Secretary of State and the Indian Industrial Commission, under the Chairmanship of Sir Thomas Holland, was set up as a result. Unfortunately, however, the impetus to industrialization provided by the War died down after a few years and many of the industries which were started during the War languished and died. The gathering storm clouds of a new world war drew the attention of Indian scientists to the unorganized state of scientific and industrial research in India

and repeated appeals were made for the constitution of a body on the model of the D.S.I.R. The urgent need for the appointment of such a body was voiced by Professor J. C. Ghosh in his presidential address to the Association at Lahore in 1939 and was reiterated in a resolution of this body last year at Madras. The same point was made by Colonel Chopra in his presidential address to the National Institute of Sciences in Madras last year and by Sir M. Visvesvaraya in an address to the Indian Institute of Science, Bangalore. We, therefore, cordially welcome the recent appointment of the Board of Scientific and Industrial Research by the Government of India in response to the demand of scientists throughout the country. Our thanks are due to the present Commerce Member, Sir Ramaswami Mudaliar, who lost very little time in appreciating the urgency of the constitution of such a body under the conditions created by the war.

I am a member of the Board and keenly interested in its success. Any observations which I may make upon it are made in a purely constructive spirit with the object of enhancing its utility to the country. In the first place then, I may be permitted to say that although the beginning of the Board, like most beginnings, may be small, its conception must be large and liberal. It must not, in its composition or working, bear the appearance of a mere *ad hoc* body created to meet the immediate exigencies of the war. The demands of the war are no doubt urgent and must have priority over other demands, but the Board should function as a body charged with the organization and promotion of industrial research throughout the country, and co-ordinate the immediate needs of the war with the long-range policy of the industrial development of the country as a whole. While concentrating on what is immediately required to meet war needs, it must also be in a position to survey the long-term industrial requirements of the country and to plan a programme of research to meet them. Perhaps after the urgent demands of the war are over, its composition can be enlarged and made more representative of the Universities, Government scientific services, the non-official scientific bodies and the industrialists of India so as to enable it to pursue its ultimate plan and policy.

No institution, however well conceived and designed, can flourish except in suitable political atmosphere and conditions. It was the unfortunate experience of the last War that industries created under the stress of the war languished and died in the post-war period for want of encouragement and protection from Government. The activities of the Board will not lead to the creation of new industries unless industrialists are assured of reasonable protection from Government in the post-war period, when foreign competition will be keen.

I have already quoted the words of Lord Rutherford as a warning against excessive Government control. The progress hitherto made by the Board is not as rapid as we would have wished in war time. This is partly due to the constitution of the Board under which executive authority is concentrated in a central department of Government and partly to the inadequate staff provided for the very urgent and important work that has to be done. There is one other aspect on which I desire to touch and that is the financial. Even for a beginning, a grant of Rupees five lakhs is inadequate and shows to my mind an inadequate conception of the magnitude of the tasks involved. Associated with the Department of Scientific and Industrial Research in Great Britain are the great National Physical Laboratory at Teddington and important Boards, such as the Fuel Research Board, the Food Investigation Board, the Forest Products and Building Research Institutes and a number of similar bodies as well as Research Associations. While we must necessarily make a very modest beginning, the development of the Alipore Test House into a National Physical and Chemical Laboratory seems to be obviously and urgently required. In a subsequent part of this address I shall dwell upon the necessities of a Fuel Research Board to investigate the very pressing problems of fuel and power, upon which the whole industrial structure of the country has to be based. All this work will require large funds but I have not the slightest doubt that the money so spent will be repaid manifold. It has been estimated that the annual expenditure on research in Great Britain in normal times before the war was roughly six million pounds, of which one-half was spent on research directed to industrial needs,

including the money spent by Government, University Departments and private firms. The figure for the U.S.A. is estimated to be 300 million dollars, while the corresponding figure of the U.S.S.R. is reported to be of the nature of 120 billion roubles. With the exception of the U.S.A. and the U.S.S.R., there is no country in the world with natural resources so vast and varied as India. With the expenditure of even a fraction of the amount spent by the countries just mentioned on industrial research, these resources can be investigated and developed so as to place India in the front rank of the industrial countries of the world.

THE STEEL INDUSTRY IN INDIA

I propose now in the second part of my address to speak to you on some developments in the steel industry in India during the last ten years; but before doing so I should like to make a few remarks on the raw materials which are commonly used in the manufacture of iron, namely, iron ore, coal and limestone, and particularly coal, which is the most important of our raw materials and of the most general interest.

IRON ORE

So far as iron ore is concerned, India is one of the richest countries in the world, being endowed by nature with very extensive deposits of very rich ore. The Singhbhum-Orissa field is the most extensive in India. The tonnage of this field has been estimated by Mr. H. C. Jones of the Geological Survey, at 3,000 millions, and, if anything, it is probably an underestimate. Practically the whole of this ore is hematite, with an iron content of sixty to sixty-nine per cent.

COAL

While the position regarding iron ore is highly satisfactory, that regarding coal, particularly the coal required for the smelting of the iron ore, is far from satisfactory. Dr. Fox has estimated the resources of Indian coal over four feet in thickness up to 2,000 feet in depth and twenty per cent. in ash at 24,000 million tons, of which coal of good quality up to 18 per cent. ash is 6,000 million tons, while coking coal suitable for metallurgical purposes is only 1,400 million tons. Coking coal in India is confined to the Gondwana coal beds of the Damodar Basin. On the existing methods of working coal the total life of the coking coals of India is estimated at about fifty years. This is a position which neither the Government nor those interested in the metallurgical industry can view with equanimity. The most recent Committee appointed by the Government of India to investigate the position and suggest remedies was the Burrows Committee of 1937. The terms of reference to that Committee were unfortunately not comprehensive enough and the legislative measures taken by Government as a result of the recommendations of the Committee are mainly confined to the ensuring of safety in Mines. The problem of Indian coking coals is, however, one of conservation as well as of safety and if proper attention is paid to conservation, the problem of safety will more or less automatically be solved. Legislation in the interest of safety which places additional burdens on the industry without assisting it to dispose of its production in a more scientific manner, is likely to worsen the situation by hastening the uneconomic exploitation of the good coals by the smaller colliery owners. What is required is the rationalization of production as well as of consumption. In order to achieve the rationalization of consumption, a thorough chemical and physical survey of the coalfields beginning with the Jheria coalfield, in conjunction with a scheme of coal utilization research is absolutely necessary.

FUEL RESEARCH BOARD

For that purpose it is necessary to create a Fuel Research Board as a branch of the Board of Scientific and Industrial Research with a proper personnel, adequate staff and funds. Power is a *sine qua non* of the development of all industries and the proper conservation and utilization of the coal resources of the country is the first question that requires to be tackled in any consideration of the power resources of the country. The geological survey of the various coalfields has been excellently and exhaustively carried out at great expense to Government and it is high time that a scientific, chemical and physical survey were also carried out. Such a survey has been instituted in Great Britain and has resulted in a mass of most valuable information regarding British coals which has in many instances completely altered the attitude of the industry to many varieties of coal and enabled a more efficient use to be made of them.

On the production side the most important problem is that of the co-ordinated sequence of working the coal seams. Perhaps the worst feature of the working of Indian collieries is the exploitation of the richer coal from the lower seams for immediate profit and the neglect of the upper seams resulting in subsidences, fires and destruction of valuable coals. The co-ordinated sequence of working will prevent this destruction of top seams and will eliminate to a large extent the necessity of stowing altogether. No. 16 seam in the Jheria coalfield is a case in point. This coal has good coking properties but because of its high ash content and doubtful swelling tendencies it has been comparatively unexploited, either as a steam or coking coal.

The washing of coals is another question affecting production. In many cases the ash in the Jheria coals is inherent or when present in a free condition is of about the same specific gravity as the coal itself, thus making the separation impossible or difficult, but it has been proved that in certain of our high ash seams the ash content can be reduced by liquid flotation. 11 and 16 seams Jheria come into this category and further research is necessary to determine whether it is economically feasible to wash these coals with a view to reduce their ash content.

On the consumption side, the chemical and physical survey into our coal seams in conjunction with coal utilization research will in the first place enable us to determine the range and variety of coals suitable for coking as well as boiler purposes. Research is necessary in order to ascertain whether with proper blending and mixing the demands of the metallurgical industry need be confined to the very limited Jheria field. Several experiments have been carried out in the past, but further systematic research by the Board suggested above into blending with high ash coking coals, with swelling coking coals and with non-coking coals may result in the conservation of good coals and an extension of the range of coals available for metallurgical purposes.

Similar research is also required in the case of power coals. A certain amount of information is already available but is mainly confined to the mixing of the high volatile coal in the Raneegunge field with the low volatile coal in the Jheria field for the export market and bunkering only. These low volatile coals from the Jheria are good metallurgical coals and research will doubtless produce suitable blends for export and power requirements without encroachment on these valuable low volatile coking coals.

The utilization of high ash coals for electrical generation at the sources of production and the distribution of the energy thus supplied over large areas is another problem of the first magnitude. The erection of a large power station on the coalfields for the distribution of cheap power to surrounding areas has already been advocated from many sources and has engaged the attention of the Government of Bihar. Further investigation of the suitability of the coal for such a purpose will help greatly towards the fulfilment of this very desirable project and should form one of the first objects of enquiry by the proposed Board.

Low temperature carbonization tests with various classes of coal, particularly of high ash, which are unsuitable for metallurgical purposes and also unsuitable on account of high ash content for transport to distant areas for power purposes, should provide another field for the activities of the Board. A number of scientists from the platform of this Congress as well as outside have advocated the cheap production of domestic coke on a mass scale and the utilization of the resultant tar for industrial purposes. The present very small production of soft coke is capable of very great extension if a market can be found for the coke as well as the resultant tar, even if the gases are ignored for the present. The economic difficulties in the way of such a proposal need not be minimized but practical experiments have already been carried out at Patna under the auspices of the Bihar Government and these would seem to indicate that further research may prove successful. Should this prove to be the case, there would be an adequate supply of raw material for the foundation of hydrogenation plants. This may be regarded as a distant aim as such plants have not proved too successful in other countries, but with the cheap Indian coals and the large quantities of tars which would be available from their low temperature carbonization success may be easier of attainment in India than in other countries.

The Board should also investigate the question of the scientific preparation of coal for the market and buying and selling on specification. This would mean the

complete abandonment of the existing unscientific system of grading. The seams which were originally graded, have become exhausted or are nearing exhaustion or have deteriorated to such an extent that the classification is in many cases no longer applicable. The disposal of the metalliferous production of the country has long been established on the international basis of scientific specification and it would be equitable to both buyer and seller alike to establish the buying and selling of coal and coke on a similar basis.

If my proposal for the establishment of a Fuel Research Board is approved, I would suggest that as the Jheria coalfield is practically the sole source of our coking coals and is also the centre of the Indian School of Mines, the headquarters of the Board should be situated at Dhanbad and the School of Mines and its laboratories which should be adequately equipped for the purpose, should be utilized for the investigations of the Board.

THE TATA IRON AND STEEL COMPANY: PROGRESS IN THE LAST DECADE

The last decade has seen a great expansion of the Steel Industry in India, accompanied by improvement in the various processes and the application of scientific methods of control. You will forgive me if I confine my remarks to the works of the Tata Iron and Steel Company alone, as the steel-making plant at Bhadravati in the Mysore State was put up in 1936 and has an annual capacity of about 20,000 tons only, while the plant of the Steel Corporation of Bengal with an estimated capacity of two hundred to two hundred and fifty thousand tons of finished steel, has begun operation very recently. In terms of tonnage, the progress can be measured by the fact that while the Tata Iron and Steel Company produced 422,000 tons of finished steel in 1929–30, the corresponding production in 1939–40 was 777,000 tons. Ten years ago only thirty per cent. of the demand of the country for steel was met by the indigenous industry, whereas in 1939–40 about eighty-four per cent. of the demand was so met and the day is not distant when India will be able to supply not only the whole demand of the country except in a few very specialized directions but also to spare some steel for export.

Coke Ovens

Following the sequence of the manufacturing processes of steel, I begin with the coke ovens, where the coal is converted into coke. Ten years ago we had three batteries of Wilputte Coke Ovens and two batteries of the still older Koppers Coke Ovens which together produced 720,000 tons of coke, 22,300 tons of tar and 6,600 tons of ammonium sulphate. By 1940 all except one of the Wilputte batteries were replaced by three modern batteries of Simon-Carves Coke Ovens containing 54 to 55 ovens in each battery at a cost of Rupees one crore and sixty-five lakhs. These batteries are of the twinflue 'Underjet' type capable of carbonizing 1,300 to 1,500 tons of coal each per working day. Arrangements have been provided for firing the ovens with coke oven gas or with the cheaper blast furnace cleaned gas. Firing the coke ovens with blast furnace gas releases the more valuable coke oven gas for use in steel-making furnaces in other parts of the plant. The twinflue construction assures a more uniform heating throughout the length and height of the oven with a resulting uniformity of the coke produced. As stated in the preceding part of the address, all coals do not give good coke and careful investigations have to be carried out in the blending and mixing of different varieties of coal. To this end three large slot bunkers of the capacity of 2,000 tons each have been installed. Coal wagons, as they arrive from the collieries, are taken over to the selected bunkers and unloaded. The coal is then mixed mechanically in the required proportions from the three bunkers and suitable mixed coal is conveyed by mechanical conveyors to the ovens into which it is charged.

The three principal by-products of the coke ovens are coke oven gas, ammonia which is turned into ammonium sulphate and tar. The sulphuric acid for the manufacture of the ammonium sulphate is made in a recently installed contact process plant producing fifty tons of 100% acid per day.

So far the manufacture of benzol as a by-product of the coke ovens has only been attempted on a very small scale in India. A plant is now nearing completion at Jamshedpur for the manufacture of benzol and toluole for the Government of India. When it comes into operation, it will be of great assistance in the manufacture of high

explosives for the ordnance factories. The plant is designed for extracting benzol motor spirit and toluole and is being installed by Messrs. Simon-Carves.

Blast Furnaces

The next stage in the manufacturing process is the blast furnace for the production of pig iron. Ten years ago, Jamshedpur had four blast furnaces; two of the capacity of 900 tons, one of 750 tons and one of 250 tons per day. The small blast furnace was completely rebuilt in 1936 and its capacity was increased to 550 tons. An entirely modern blast furnace was installed last year. The diameter of its hearth is 22 feet 6 inches, of the bosh 26 feet 6 inches and of the top 19 feet. Its height is 95 feet and volume 35,160 cubic feet. For the one year that this furnace has been in operation it is estimated to have produced more iron than has ever been produced elsewhere on a furnace of similar size over a similar period. The total pig iron capacity of the Jamshedpur plant is a million and a quarter tons per annum.

For every ton of iron made, a blast furnace produces roughly 100,000 cubic feet of gas. This blast furnace gas contains about 14 grains of dust per cubic foot of gas at N.T.P. This gas has considerable fuel value, but owing to its dirty condition its use in industrial plants, such as blast furnace stoves and boilers is restricted. It has been realized that considerable fuel economy can be effected if this gas is cleaned. In the last ten years the Steel Company has installed two large gas cleaning plants, each with a capacity of fourteen million cubic feet of blast furnace gas at N.T.P. per hour. Both the plants clean the gas to a purity of 0·008 grains of solids per cubic foot of gas at N.T.P. The older of these two plants is the Lodge Cottrell plant of the dry type which came into operation in 1934. The second gas cleaning plant is of the Brassert design. This plant consists of wooden-hurdle wet washers which not only cool the dirty blast furnace gas but also remove about eighty per cent. of the solids from the gas. This semi-cleaned gas is then passed through the Cottrell wet electric precipitators which precipitate the rest of the solids and deliver clean gas to specification.

Fuel Economy

The old concepts of fuel economy and energy distribution have been completely revolutionized by the modern scientific use of coke oven and blast furnace gases. Fuel economy and distribution of energy in a large plant like that of the Tata Iron and Steel Company is a highly specialized job, which is in charge of a special department of the plant, designated the Energy and Economy Department. The efforts of this department have succeeded in reducing the overall fuel rate from 3·56 tons of coal per ton of steel in 1930–31 to 2·19 tons in 1939–40. Modern practice aims at reducing the use of coal as fuel and replacing it by the more efficient by-product fuels, such as coke oven gas, blast furnace gas, coke dust, etc. The use of mixed gases in this connection requires special mention.

The cleaning of the blast furnace gas permits of its use in coke ovens and releases a corresponding amount of the richer coke oven gas for use elsewhere at the plant. Blast furnace gas has a comparatively low heating value of about 110 B.T.U. per cubic foot of gas, while coke oven gas has a value of about 470 B.T.U. per cubic foot. Modern practice tends to a greater use of coke oven gas or a mixture of coke oven and cleaned blast furnace gas in steel making and reheating furnaces, replacing to that extent coal which has been used so far in the form of producer gas. Fuel costs are thus greatly reduced. For the successful use of the gases it is necessary to have steady pressure of gas at the consuming ends. For that purpose two large dry gas holders for the storage of blast furnace and coke oven gas respectively have recently been installed. These gas holders act as reservoirs which smooth out the fluctuations of the gas caused by the furnace irregularities and thus assure continuous operation of boilers, coke ovens and other consuming centres. The blast furnace gas holder is a huge structure 283 feet high, 176 feet in diameter, capable of holding 5½ million cubic feet of gas at N.T.P. The coke oven gas holder is 192 feet high, 112 feet in diameter and holds 1½ million cubic feet of coke oven gas.

Steel-making Practice

The last ten years have also seen important developments in steel-making practice and a considerable increase in production.

Steel-making operations at Jamshedpur are carried out in two types of plants, the Open Hearth and the Duplex. The Open Hearth is the oldest part of the Jamshedpur

plant. Four out of the seven furnaces which we were working ten years ago, have been remodelled along modern lines and an eighth furnace has been built. The ingot production from this plant has been increased during the last ten years by over 100,000 tons per year, the figure for 1929–30 being 242,000 tons as compared with 345,000 tons in 1939–40. The Duplex steel-making process, as its name implies, consists of two operations, (*a*) blowing the molten pig iron in acid lined Bessemer Converters to remove the silicon and manganese and most of the carbon, and (*b*) transferring the blown metal to basic-lined Open Hearth tilting furnaces where the phosphorus is removed and the steel finished to chemical specification. Improvements to this plant during the last ten years have resulted in increase of production from 340,000 tons in 1929–30 to 670,000 tons in 1939–40. In addition to these two steel-making plants a four-ton electric furnace was installed in 1936 mainly for the manufacture of electric castings, while two five-ton electric furnaces have only recently been installed and are being utilized for the manufacture of class steel, spring steel and alloy steel. The installation of these electric furnaces has been of the greatest assistance in the making of superior quality of alloy steel required by the Defence Department.

A New Steel-Making Process

The most important advance made during the last decade, from the point of view of scientific research, is the practical development of the rapid dephosphorizing process. As this matter has never been the subject of public discussion in India so far, a few details will not be out of place here. As is well known, Indian pig iron contains about ·3 to ·4% phosphorus. This percentage of phosphorus in the iron neither lends itself to the straight basic Bessemer process nor to the straight acid Bessemer process. The phosphorus has to be removed to ·05% for most commercial specifications though as much as ·10% is admissible in certain products. The removal of this phosphorus is normally effected by the action of basic and oxidizing slags in Open Hearth furnaces. At the best of times this is a slow operation taking from one to several hours even in the quick working Open Hearth furnaces of our Duplex plant. In 1935, when our General Manager, Mr. Ghandy, and myself were on leave in Europe, our attention was drawn to certain developments in France, where a French Steel Engineer, M. Perrin, had carried out successful experiments in the rapid deoxidation of steel by violent mixing together of slag and steel so as to obtain a considerably greater area of contact between them than could ever be obtained in the conventional Open Hearth furnaces. This idea of the violent mixing of slag and steel was also considered applicable to the dephosphorizing operation. After a study of the French experiments, large-scale investigation over a long period was carried out at Jamshedpur and ultimately a practical method was evolved for operating the dephosphorizing process on a commercial scale under Indian conditions. This new process consists in blowing molten pig iron in an acid Bessemer converter to remove all the silicon and manganese and as much of the carbon as required. This blown metal is then poured from a considerable height into a synthetic molten basic oxidizing slag contained in a ladle. The metal comes into very intimate contact with the slag and the phosphorus is rapidly removed in the course of two or three minutes, instead of as many hours, in the normal open hearth process. As the steel and slag separate, the steel is finished to analysis and cast into ingots. The process is subject to exact control and steel of basic Bessemer quality can be made directly from the pig iron. Moreover, the dephosphorized metal can be further treated in an Acid Open Hearth furnace and steel of first class open hearth quality can be made. Thus for the first time in India it becomes possible to make acid steel out of Indian basic pig iron. A plant for the manufacture of steel by this process is now under construction. The successful development of this process may be regarded as the most important advance in steel making practice that the young Indian steel industry has made. It is likely to have far-reaching effects on the establishment of several new industries in India, such as locomotive manufacture and the manufacture of railway wheels, tyres and axles, for which acid steel is specified.

Rails

In the manufacture of rails, advance has been made as a result of metallurgical research during the last ten years. Investigations have shown that medium manganese rails with a lower carbon and higher manga-

nese content of 1·10 to 1·40% have superior properties of wear and resistance as compared to straight carbon rails with higher carbon and lower manganese content. There is a growing tendency to replace straight carbon rails with medium manganese rails. On the other hand, high chromium rails were found unsatisfactory.

An interesting advance has been the installation of Sandberg Ovens for the Sandberg controlled cooling process for rails. All over the world the controlled cooling of rails has come to be looked upon as a definite and desirable advance on the old practice of cooling rails on open hot-beds. The Tata Iron and Steel Company have obtained exclusive rights in India for the working of the Sandberg process. They have installed four Sandberg Ovens for the controlled cooling of their rails. Experiments are also being conducted in the welding of rails in the track. This aims at giving longer lengths in the track between joints and helps to provide a smoother ride.

Plates

In the Plate Mill, the most interesting development in the last decade is the installation of a modern normalizing furnace for plates. This furnace was first installed to normalize some of the high tensile steel plates for the new Howrah Bridge. By the aid of this furnace it is now possible to produce in India normalized plates which had formerly to be imported. The furnace is also used to normalize certain structural sections. Thus materials with a new range of physical properties have been made available to the designing engineers. It is worth noting that Indian plates have largely replaced foreign plates even for the most exacting demands, such as for barges and ships.

Sheets

Ten years ago, the Sheet Mill at Jamshedpur consisted of five hand-operated units and the total annual production was 38,000 tons. The rolling of sheets was an extremely strenuous manual operation calling for considerable physical exertion. Production was low, defects and rejections were high. To-day we have only four hand-operated mills and three mechanized units with an output of 170,000 tons. These new mechanized units have produced tonnages which, as far as can be ascertained, constitute a world record for this type of equipment. Besides the ordinary quality mild steel sheets, the Jamshedpur plant now turns out different classes of sheets with a high grade finish, including 'Tiscor' and high carbon sheets. Panel plates for coach building are supplied to the Railways and the various engineering firms. Other special developments in sheet manufacture are the rolling of drum stock for the manufacture of drums and containers, enamelling stock for deep-drawing and subsequent enamelling, furniture stock and, lastly, special sheets for steel helmets for the army.

Low-alloy Steels

It is owing to applied research that most of the significant advances in the steel industry at Jamshedpur during the last decade have been made possible. I have already mentioned the case of the rapid dephosphorizing steel. The development of low-alloy steels is another very important instance. Engineers in general and transportation engineers in particular are beginning to realise that ordinary carbon steel performs its functions only at the expense of unnecessary dead weight and excessive loss due to its low resistance to corrosion and abrasion. The problem of providing suitable materials for lighter weight is not one relating to mechanical strength alone. It requires the integration of several properties in one material, such as strength, resistance to impact, corrosion and abrasion, ease of forming, satisfactory welding, etc., as well as moderate cost. With this end in view, metallurgical research was conducted at Jamshedpur, resulting in the development and commercial manufacture of a low alloy, high-tensile steel containing copper and chromium known as 'Tiscrom'. This steel is being employed in the construction of the new Howrah Bridge.

The introduction to India of another low-alloy high-tensile steel, sold in America under the trade name 'Corten' deserves mention. Research conducted in America had shown that the addition of a high percentage of silicon and phosphorus to alloy steel, containing chromium and copper, resulted in a low-alloy high-tensile steel of the same properties as those of Tiscrom but with the additional important property that it could be readily welded by all methods of rapid welding such as oxy-acetylene and automatic electric welding. After an investigation into the possibilities of the manufacture

of this steel in India and an examination of the claims put forward for it, the Tata Iron and Steel Company obtained exclusive rights for the manufacture and marketing of this steel in India under the trade name of 'Tiscor'.

Special Steels

Reference has already been made to the installation of the electric furnaces. Among the special qualities of iron and steel manufactured from these furnaces are chrome-manganese steel for crane track wheels, thirteen per cent. manganese steel for crusher jaws and similar hard wearing parts of machinery, nickel-chrome heat-resisting steel and cast iron for various castings required to withstand high temperatures and nickel-chrome-molybdenum steel for crane pinions, mill rolls, etc. The manufacture at Jamshedpur of special alloy steel rolls has enabled the Steel Company to replace similar rolls of foreign manufacture.

Since the outbreak of the war, intensive research work has been undertaken for Government in connection with the manufacture of armoured vehicles in India, and as a result a bullet-proof armour plate of special alloy steel which has stood the firing tests and has been accepted by Government, has been developed. Suitable steels for the manufacture of armour piercing shot and for steel helmets have also been produced. Research work was undertaken at the instance of Government in regard to the supply of steel suitable for telegraph wires. This steel has now been successfully manufactured and the wire rolled at the works of the Indian Steel and Wire Products out of this material has met with the approval of the Department of Posts and Telegraphs.

Researches are being carried out on behalf of the Defence Department in connection with the welding of chrome molybdenum steel plates for aircraft manufacture and in other directions.

Most of the high speed steel requirements of the plant for machine tools are now being met by the remelting of tool scrap in the high frequency induction furnace in our laboratories. High chrome and stainless steels have been produced in the furnace in small quantities.

Besides metallurgical research, fuel research, chemical research and research in refractories are being pursued. Researches of the fuel department in blending and mixing have resulted in the determination of the most suitable varieties of coals for coking and similar purposes. Research on refractories has enabled us to evolve a better class of refractories for the use of the steel plant. Indian raw magnesite was at one time considered unsuitable for use in basic steel furnaces. Investigations carried out at Jamshedpur have now made it possible to produce in India the Steel Company's entire requirements of finished magnesite. Metal-cased magnesite bricks made at Jamshedpur have given very encouraging results for the superstructure of basic furnaces. Chrome magnesite brick for use above the slag line in basic Open Hearth furnaces in place of silica brick is another important development in the refractory field. Other interesting developments in brick manufacture are investigations into the possibilities of the manufacture of foresterite, semisilica, mica-schist and mullite bricks. An entirely new process has been developed for the manufacture of mullite refractories using cyanite, silimanite and alusite, India having practically a monopoly of the first two. Very productive work has also been accomplished with regard to high-temperature mortars. Superior types of mortars for high temperature work are now being locally made, replacing many of the imported brands.

A Nucleus for a National Metallurgical Laboratory

To facilitate research work, a modern well-equipped laboratory was erected in 1937 at a cost of over rupees ten lakhs. May I express the hope that with the facilities for metallurgical research provided by this laboratory and its workers, Jamshedpur may in the near future become the centre of a National Metallurgical Laboratory and Research Institute and thus be enabled to play a greater and worthier part in the development of the metallurgical industry in India.

When the titanic conflict now being waged ends, as end it must, in the triumph of the democracies and the cause of human freedom, I pray that India may emerge from it with the foundations of its industrial as well as political freedom well and truly laid, so that she may be properly equipped to play her rightful part in peace and in war as a worthy member of this great commonwealth of nations.

LIBRARIES AND LIBRARY MOVEMENT

BY
S. R. RANGANATHAN
(*University Library, Madras*)

ON the 5th of November 1940, the Public Library at Bangalore celebrated the Silver Jubilee of its installation and the event may be used as an occasion for reviewing the library movement in India.

The sister State of Baroda had already made a name in library matters when the Bangalore Public Library was established. For as early as 1907 the late Gaekwad had instituted public libraries in the State. In 1910 he secured the services of Mr. W. A. Borden, an American librarian, to work out a library system for his State. Mr. J. S. Kudelkar was the first Indian librarian to take charge of this library system. In collaboration with Mr. M. N. Amin he developed the Central Library, the numerous local libraries and the travelling library system.

The example of Baroda did not take long to stimulate Mysore. In 1914 two public libraries of the modern type were established, one in Mysore and the other in Bangalore. These libraries were formally opened to the public in 1915. They were managed directly by the Government till 1921 when they were transferred to the care of mixed committees of officials and non-officials.

The first British Indian province to think of a library system was the Punjab. In 1915 its university engaged the services of Mr. A. D. Dickinson, an American librarian again, to reorganise its library on modern lines. Fortunately for the Punjab he went beyond his scheduled work, organised a library training class, wrote the *Punjab library primer* and initiated the library movement in the province. Thus again 1915 turns out to be an important date in the library history of India.

Taking our stand on that year let us have a look backwards and forwards. Isolated libraries had existed all along from very early days. But they do not constitute library movement. The apex of such isolated libraries in the provinces was constituted at Calcutta with the name Imperial Library by the Curzon Act I of 1902.

On the non-official side the Andhradesa has done pioneering work. The first Andhra library is said to be the one started about the year 1898 in the village of Kumudavalli in the West-Godavari district by Ganjam Venkataratnamgaru. The library workers of Andhradesa had also been actively sponsoring an All-India Library Conference during the twenties, as one of the many auxiliary conferences associated with the Indian National Congress.

Work through non-official library associations has now become a regular feature. The Madras Library Association was founded on the 30th January 1928 and the Punjab Library Association on the 30th January 1929. The Andhradesa Library Association and the Bengal Library Association had come into existence a few years earlier. An All-India Library Association was formed in 1933 and is holding biennial conferences. Since that date provincial library associations have been formed in some other areas like the United Provinces (1935), and Bihar (1939).

The Andhradesa library workers have the credit of having started the first library periodical. It was called the *Indian library*

journal. It sent out a few issues at irregular intervals and it seems to have now gone into suspended animation.

The Punjab Library Association inaugurated the *Modern librarian* in November 1930. It began first with the ambition of being a monthly. After the first two issues it was put to the necessity of issuing double numbers in alternative months. Now it has avowedly declared itself a quarterly. It has completed ten volumes of considerable value.

The Bengal Library Association has been issuing a *Bulletin* at regular intervals. The combined numbers 1 and 2 of volume 2 which came out in 1938 appear to be the latest ones.

The Andhradesa Library Association started a bilingual quarterly entitled *Andhra granthalayam* early in 1939. It has just now completed the first volume by clubbing issues 3 and 4 into a double number.

The Madras Library Association has inaugurated an annual periodical with the title *Memoirs of the Madras Library Association.* The first volume came out in April last.

Of all the different Library Associations of the country it is the Madras Library Association that is most prolific in its publications. It has inaugurated three important series of publications: Everything About Something Series; Bibliographical Series and Publication Series.

The first is an attempt to bring out books on current thought in modern Tamil, as such books are not easily forthcoming in the book-market of the province. Two books have come out in this series till now.

Sixteen items made up of book-selection lists in South Indian languages, library companions to certain text-books and bibliographies in certain subjects have appeared in the bibliographical series.

The volumes of the publication series form the most considerable contribution of that Association to the world's library literature. Nine volumes have come out so far. Three more are in preparation. The intention is to cover all branches of Library Science. The basic book is the *Five laws of library science* (1931) which in the words of Sir P. S. Sivaswami Iyer "reduces everything connected with the libraries to five cardinal principles from which all the rules of library organisation and management are developed as necessary implications and inevitable corollaries". The other volumes cover the fields of classification cataloguing, administration, reference service and bibliography. Another publication of some value on reference service was published this year by Mr. Fazl Elahi. Library movement cannot flourish in our land unless substantial treatises come out continuously from all parts of India.

The Madras Library Association has also the credit of having made two outstanding contributions which have received international recognition. They relate to classification and cataloguing.

The Colon Classification sponsored by that Association has many novel features of which its composite nature is the outstanding one. The *Library Association record* (London) estimates it with the words "The result is almost perfect. ... A new subject creates its own number in the notation". The *Year's work in librarianship* pronounces it to be the best exercise in synthetic classification. On account of its composite nature and the eight devices it has developed, it carries the individualisation of ideas and subjects to a far greater degree than any other scheme.

The Association has also sponsored what is perhaps the only complete code in book

form in the English language for the preparation of a classified catalogue. The *Library Association record* (London) estimates the *Code* as one of considerable value.

The credit of having started the first school of librarianship in India goes to the Punjab University Library. It was inaugurated in 1915 and is still being continued as a six months' course every alternate year.

The second school of librarianship was founded by the Madras Library Association in 1929 as an annual summer school for three months. This was taken over by the University of Madras in 1931. In 1938 the course was converted into a full-timed one year one leading to the University diploma. About 130 persons have been so far trained by the Madras school.

The third school of librarianship was begun by the Andhra University in 1934 on a rather ambitious scale out of all proportion to what was warranted by the library conditions of the country. It had to be suspended from 1937.

Another school of librarianship is being conducted in alternate years by the Imperial Library at Calcutta.

The Bengal Library Association is also giving occasional short courses.

The outstanding library buildings of the modern type that were completed during the last few years are those of the Central Library at Baroda and the University Libraries of Lahore, Benares, Madras, Waltair, Annamalainagar and Lucknow. In most of these libraries the buildings are designed to suit the open access system. Most of them are also provided with artificial lights so as to make it possible for the libraries to work during nights. The longest hours are kept by the Madras University Library which works on all the days of the year without exception, for 13 hours from 7 A.M. to 8 P.M.

The above resume of the recent history of Library Movement in India significantly omits mention of any considerable State action, in particular, of library legislation, which forms the basis of continued library development in other countries of the world. The first attempt at promoting library legislation was made at the Library Service Section of the First All-Asia Educational Conference held at Benares in 1930. A Model Library Act with compulsory clauses was presented to that Conference. This Model Act was made the core of the *Five laws of library science.*

Munindra Deb Rai Mahasai had the Model Act adapted to the conditions of Bengal and sought to introduce it in the Bengal Legislative Council. But it was disallowed by the Viceroy. The Madras Library Association promoted a public library bill on the lines of the Model Act but converting all the compulsory clauses into optional ones to avoid opposition from government. The Viceroy's consent was received and the support of most of the district boards and municipalities who were to be created library authorities was also obtained. The bill was introduced into the Legislative Council by Mr. Basheer Ahmed Sayeed in October 1933. It came out of the Select Committee stage in 1934, but all further progress was blocked by the unfriendly attitude of the then Finance Member. Though it was not formally withdrawn the bill lost its life by the dissolution of the Legislative Council in 1936. On the reconstitution of the legislature under the Government of India Act, 1935, Mr. Basheer Ahmed Sayeed gave notice in October 1937 to introduce the bill in the Madras

Legislative Assembly. But it was not permitted by His Excellency the Governor.

It is a matter of experience all the world over that Library Movement cannot take root and thrive, if it is made to depend purely on private philanthropy or the enthusiasm of private individuals. Nor will it receive the necessary attention of the local bodies simply because libraries are mentioned in a schedule of the Local Boards Acts among the various purposes on which a local body may spend any money that it may occasionally spare. Local bodies will go the whole hog in the matter only if there is a separate public library act implemented by a department of public libraries presided over by a professional librarian.

The experience of several countries points to the need for even a more drastic step with compulsory clauses in the public library acts which empower penalties being imposed upon local bodies which do not exercise their library function with sufficient vigilance and to a prescribed standard.

Library legislation will be required if the country is to be filled with a co-ordinated network of live public libraries capable of functioning as efficient instruments of universal education. That, as we have seen, we are yet to have in India. But so far as the needs of the intellectual aristocracy go, it can be said that India is well provided by its university libraries and the libraries of the various departments of the Government of India and of the several Research Institutions. Before the last world depression, money was easily forthcoming and many libraries were well provided for. It was this fact that brought their resources to an adequate level. But of late the finances of most of the libraries are being crippled. If a more generous and far-sighted policy is not inaugurated it will not be long before even the combined resources of all such libraries prove inadequate to the requirements of the nation-building research activities.

Will it be too much to hope that the Government and universities will strive their very best to continue their library policy along liberal lines? Will it be too much to hope that they will realise that money spent on libraries is not money thrown away for ever, but on the other hand every pie spent on increasing the resources of the libraries and on improving their man-power and their service to the public will come back to the community in the form of extended literacy and efficient citizenship.

It is true that the war in which the country now finds itself entangled and the political abnormality that prevails in the land make the present moment inopportune to speak of library reforms, library legislation and above all finance for libraries. But surely the war is not going to be a perpetual feature of the world. Similarly the present political impasse is not going to be permanent. It is not asking for too much if we appeal to those who now wield the power that the libraries should not be starved at least for the obvious economic reason that the gaps now created will cost far more than now to get filled up later. Countries which are in the thick of the fight have not developed any serious indifference to the library needs of their people. Again thanks to the activities of library associations a good deal of popular enthusiasm has been created for libraries. If the enthusiasm is made to die out by a stingy policy, it would be far more difficult to whip up enthusiasm a second time.

THE RUMANIAN EARTHQUAKE OF NOVEMBER 10, 1940

BY

A. R. PILLAI

(Colaba Observatory, Bombay)

A VERY severe earthquake shook Bucharest and parts of Rumania at 7-09 a.m. Indian Standard Time (3-39 a.m. Rumanian Standard Time) on Sunday, the 10th November 1940. In Bucharest, according to Reuter's reports, the earthquake lasted for five minutes causing great damage. Almost all the buildings in the city were damaged, the Carlton building, an eight-floored sky-scraper, crashed and many people were caught in the debris and perished; hundreds of domes, chimneys and towers came down like ninepins and not a single ceiling was left intact. There were also explosions of oil tanks causing many fires. In the provinces, Galatz is reported to have suffered the highest death roll and the greatest damage; in Foscani the centre of the city was completely destroyed and in Ploesti many buildings crashed; in Campina, Baicoui, Bustenari, Buzeau, Rumical and Sarat in the oil regions, there were explosions of oil tanks and breaking of pipe lines and considerable destruction of property and many casualties. In Bulgaria, the shock was reported to have caused some victims.

The earthquake was felt very severely in Kiev in Ukraine, Sinope and Inebolu in Turkey on the shores of the Black Sea and less severely in Budapest, the Hungarian capital. A shock was also reported to have been felt in the Marseilles region. Reports about the amount of damage and consequent loss of life are so far vague, evidently due to the present unsettled conditions in Europe. However, it is believed that the number of dead may not be less than 1,000.

The maximum intensity of the earthquake as obtained from the available macroseismic data is about VIII in the modified Mercalli scale (VIII–IX in the Rossi-Forel scale), and the area over which this intensity was observed is found to be over 10,000 square miles. The extent of the area over which the earthquake was severely felt is as large as 500,000 to 600,000 square miles. The great extent of the area in which the shock was severely felt with relation to the observed maximum seismic intensity suggests an abnormal depth of focus.

Rumania lies a little to the north of the Alps-Caucasus-Himalaya seismic belt. Earthquakes in this (Rumanian) region have not been as frequent as in Italy, Greece and Bulgaria which lie well inside the belt referred to above. In Milne's[1] *Catalogue of Destructive Earthquakes*, only 14 shocks were listed in Rumania in the whole of the nineteenth century beginning with the disastrous one of 1802. In the last twenty-five years, no destructive earthquake appears to have occurred though about ten shocks were recorded having their epicentres in Rumania. Of late, this region appears to have become seismically active. Three shocks were reported to have been felt in Rumania on February 1, 1940, the epicentre of which, according to Bucharest seismologists, lay in the Black Sea, 500 miles east of the Rumanian capital. These were not recorded by the Bombay seismographs. Another shock, which was, according to *Nature*,[2] one of the greatest during that month occurred on February 29, 1940. The epicentre was near Lat. 45° North and Long. 27° East in Rumania, according to Zurich seismologists. This was recorded by the seismographs in India as a shock of moderate intensity, but the tentative epicentre as determined at Bombay on the basis of Indian seismograms and published data of a few European and African stations was Lat. 34° North and Long. 25° East, near the island of Crete.[3] This differs much from the Zurich determination. In this connection, it may be noted that the only damage reported was from Afium Karahisar in Anatolia. This indicates that the epicentre given by Bombay is nearer the affected area. On October 22, 1940, a slight shock was recorded by the Indian seismographs and the epicentre was near Bucharest where according to Reuter's report three shocks were felt bringing down house-fronts and ceilings.

The destructive earthquake of November 10, 1940, was recorded by all the seismographs in India, and the epicentre as tentatively determined at Bombay, immediately on receipt of telegraphic reports from Agra and

Calcutta was near Lat. 44°·5 North and Long. 27°·0 East about 60 miles away from Bucharest. The first movements as recorded by the Bombay seismographs give an azimuth of about 30 degrees West of North while the tentative epicentre lies about 38 degrees West of North. The tentative epicentre agrees well with the centre of the area of destruction which is near Lat. 45° North and Long. 27° East. The depth of focus of the shock was found to be about

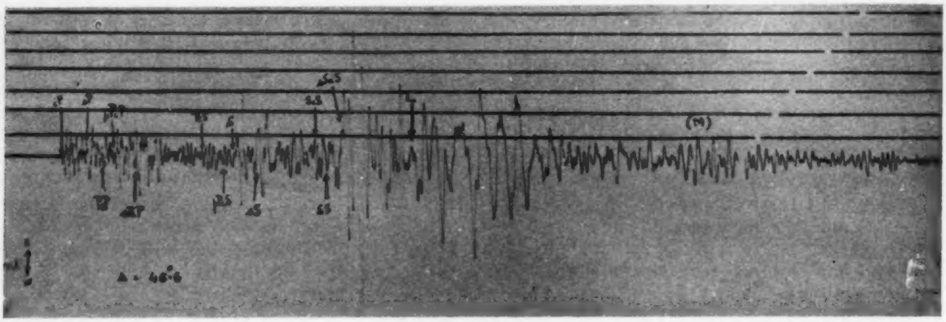


FIG. 1

150 km. from the Bombay seismograms and this is supported by the Hyderabad records, which were kindly loaned by the Director of the Nizamiah Observatory, Hyderabad, Deccan. The Calcutta seismograms and the data which were received just at the time of going to press also give about 145 km. The same order of depth was obtained from the macroseismic data using the well-known relationship[4a] between the observed maximum seismic intensity and the area over which the shock was felt.

The Bombay seismogram of the Rumanian earthquake as recorded by the Milne-Shaw East-West component is reproduced in Fig. 1. The great number of clear phases, which is a regular feature of deep focus seismograms, is to be noted. The maximum movement is recorded after sScS. The very well developed long-period waves commence with great amplitude and are followed by poor 'maximum' waves.

In their study of Depth and Geographical Distribution of Deep-focus Earthquakes all over the world, B. Gutenberg and C. F. Richter[5a,b] have listed only two deep shocks with their epicentres in Rumania as shown below:—

Date	Epicentre	Depth of focus
1929, Nov. 1 .	45°·9 N., 26°·5 E.	160 km.
1938, July 13 ..	45°·7 N., 26°·7 E.	150 km.

Though most of the deep focus shocks are confined to the Pacific, a few isolated regions are found in Europe and Asia where intermediate* shocks are known to occur. In Europe, there are two such regions, *viz.*, Rumania and the Aegian Sea. According to B. Gutenberg and C. F. Richter,[4b] "the isolated intermediate shocks in these regions are all related with active or comparatively late vulcanism".

* Earthquakes are classified by modern seismologists into normal, intermediate and deep ones. Normal shocks are those which have their origin comparatively near the surface, the intermediate ones originate at depths varying from 30 km. to 250 km. and the deep ones are from 250 km. to 700 km. from the surface.

1 J. Milne, *Report of the British Association for the Advancement of Science*, **1911**, p. 649–740.

2 *Nature*, 1940, **145**, 460.

3 *Seismological Bulletin, India Meteorological Department Jan.-March*, **1940**, p. 10.

4a B. Gutenberg and C. F. Richter, *Bull. Geol. Society of America*, **49**, 269.

4b — —, *Ibid.*, p. 281.

5a — —, *Ibid.*, p. 267.

5b — —, *Ibid.*, **50**, p. 1519.

THE INDIAN ACADEMY OF SCIENCES

THE sixth Annual Meeting of the Indian Academy of Sciences was held at the Andhra University, Waltair, on Friday, the 27th December 1940 and the three following days. The session was inaugurated by the Maharajah Sahib of Jeypore at 6 p.m. on the 27th at the Convocation Pavilion of the University in the presence of a large and distinguished gathering of Fellows of the Academy, Delegates from various Universities and Research Institutes, members of the Reception Committee and the elite of Waltair. Welcoming the Fellows and the Delegates, Dr. C. R. Reddy, the Chairman of the Reception Committee, traced the growth of modernism in scientific education in India and stressed the importance of scientific research for the successful prosecution of modern warfare. He aptly remarked that "the front line of defence has shifted from the battlefield to the Nations' research laboratories and manufacturing centres" and "any amount of money invested by a wise Government in strengthening the research institutions and developing new industries under the control of men who possess a sound knowledge of the fundamental sciences will, far from being a waste, go a long way to make the country safe and strong". Sir C. V. Raman, the President of the Academy, then delivered his Presidential address on "Crystals and Photons", a detailed summary of which appears elsewhere in this issue.

The Scientific meetings of the session were held on 28th, 29th and 30th instants. Forty-four papers in Section A, Mathematical and Physical Sciences, and fourteen papers in Section B, Biological Sciences, were communicated for the meeting. About twenty papers were read by the authors present and were followed by lively discussion. The rest were taken for read.

Symposium.—A symposium on the "Natural Resources of the Andhra Area and Allied Topics" was held under the auspices of the Academy on the 29th instant. Thirteen papers bearing on the various aspects of the subject were presented. They fall under four groups, (1) Fauna and Flora, (2) Mineralogical and Geological, (3) Electrical and (4) Chemical. A brief summary of the proceedings is given below.

In an interesting paper on the "Faunal Resources of the Andhra Area", Dr. H. Srinivasa Rao gave a rough outline of the fauna of the Andhra country from a knowledge of its physical environment and of the geographical distribution of animals in the Oriental Region (a faunistic division of the world in whch the Andhra area is included). The richness of the tract both in animal and bird life, the abundance and variety of marine and freshwater fish in the seas along its long coast and in the lakes and rivers and the wide distribution of the several Indian species of invertebrates which could be expected in this area, were brought out by Dr. Rao together with the important role animal life plays in the economy of Nature. Two other papers in the series contained discussions of the "Paleontology of the Rajahmundry area", (1) the "Fossil Fauna" by Mr. S. R. Narayana Rao, and (2) "The Fossil Flora" by Mr. K. Sripada Rao. A detailed review of the "Flora and the Plant Resources of the Andhra Area" was given by Mr. J. Venkateswarlu.

Three papers were presented on the "Mineralogical and Geological" resources of the Andhra country. Dr. C. S. Pichamuthu gave a survey of the geological antiquities of the rocks found in many districts and the mineralogical deposits found in the Andhra areas lying on the borders of the Mysore State. In his paper on "Metalliferous Minerals" Dr. M. S. Krishnan dealt with the occurrence of metallic ores in several districts in the Province. Dr. C. Mahadevan communicated a paper on the "Minerals of the Andhra Desa" in which he suggested that a careful geological survey and prospecting for minerals in this area would yield fruitful results. The vast possibilities for the development of the ceramic industries were stressed by Dr. G. Gopala Rao. The raw materials such as red burning clay, fireclays and deposits of graphite which occur in the Andhra area in abundance form the basic materials for the manufacture of structural ceramics, refractories, crucibles, etc. Dr. Rao also gave an account of a survey of raw materials for fine ceramics carried out by him and displayed some articles made by him in the Andhra University.

On the Electrical side, Mr. A. R. N. Rao read a paper on the "Resources and Development of Power in Northern Circars" and indicated the rapid progress being made in

the generation and distribution of electric power by means of charts and figures. He also made some valuable suggestions for the economic use of power in industries, and for the planned development of a network of industries in the country. Mr. D. Seethapathi Rao dealt with the possibility of hydroelectric power development in the Andhra Northern Circars. Mr. S. S. Moorthy Rao in his instructive paper on the "Wireless Engineering Developments applicable in the Andhra area" indicated the urgent necessity for the installation of a wireless communication and a wireless Broadcasting Station in the Andhra Province. Illustrating by means of lantern slides what has been achieved in the Posts and Telegraphs Department of the Government of India, he further indicated the vast possibilities of manufacturing wireless component parts with the raw materials available in the Andhra area.

Dr. T. R. Seshadri gave a detailed account of the "Resources for Organic Chemical Industries" under three main headings: (1) agricultural, (2) forest products and (3) marine products. He also presented the results of the investigations carried out by his co-workers and himself in the Andhra University in the various branches of Chemical industry, such as (1) vegetable drugs and insecticides, (2) fruits, (3) wood distillation and power alcohol, (4) dyes and tans, (5) paper, (6) oils and soaps and (7) gums, resins and wax. Mr. C. Venkata Rao also read a paper on the "Paint and Varnish Materials of Andhra Desa".

In view of the importance of the subject-matter dealt with in the symposium and the many valuable and constructive suggestions put forward by the authors, it is proposed to publish the Proceedings shortly.

Public Lectures.— Three general addresses were given during the session. On 28th December Sir C. V. Raman delivered an illustrated lecture on "Structural Colours". On 29th December, Dr. Herre, Professor of Zoology, Stanford University, gave a very fascinating talk on "Fishes and Fisheries". On 30th December, Dr. K. S. Krishnan, F.R.S., discoursed on "Magnetic and Other Properties of Graphite Crystals".

Socials and Excursions.—During the session the Fellows and Delegates were entertained at Tea by the Reception Committee, the Pro-Chancellor and the Research Students' Association. An enjoyable excursion to the Vizag Harbour was also included in the programme.

BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH

AN important decision taken at the meeting of the Board of Scientific and Industrial Research, held at Calcutta on 9–10 January 1941, relates to the constitution of an **Industrial Research Utilisation Committee**, to be composed mainly of industrialists. The Commerce Member to the Government of India will be the Chairman of the Committee which is "to advise the Government regarding the best means of utilising the result of researches, which have proved commercially possible. It will also advise the Government regarding the terms on which the results of these investigations, the patent rights of which are vested in the Government, could be handed over either to existing industrial concerns or to new concerns which might have to be created".

The Hon'ble Sir A. Ramaswami Mudaliar, who presided over the meeting, in his opening speech congratulated, on behalf of the Board, the recipients of Honours in the new year who included Lala Sri Ram and Dr. Bhatnagar (both knighted) and Mr. Pillay, the Secretary of the Board, who had been awarded O.B.E. He remarked that it was exactly nine months since the Board had been constituted and that some of the results of the researches and investigation were now beginning to come in. The Director of Industrial Development and some of the members of the staff had achieved results of practical interest to industrialists and the stage had been reached when their exploitation had to be considered. He announced that the Government had decided to constitute an *Industrial Research Utilisation Committee* to assess the commercial worthiness of these researches and encourage their industrial exploitation.

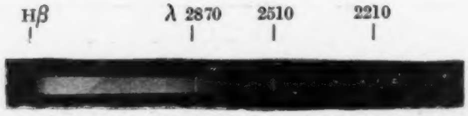
LETTERS TO THE EDITOR

EXCITATION OF LIGHT EMISSION FROM QUARTZ UNDER IMPACT WITH CANAL-RAYS OF HYDROGEN AND NITROGEN

Excitation has been observed with canal-rays of nitrogen and hydrogen of different energies lying between 4–12 kV., with time of exposure of 2 hours each. The discharge tube used is 3·5 cm. in diameter, with a canal of moulded aluminium 0·7 cm. in length and 0·2 cm. in diameter. The quartz window is fixed to the observation chamber of the discharge tube, at a distance of 5·0 cm. from the canal in such a manner as to make an angle of about 45° with the axis of the tube. Direct light from the canal-ray beam was eliminated by suitable precautions. For lower voltages, the intensity of the light given out by the bombarded portion of the window is very feeble. Visually the light given out appears to be predominantly rose-red in colour (in the case of canal-rays of hydrogen) with a tinge of greenish-blue. In the case of bombardment with canal-rays of nitrogen the greenish-blue colour is more prominent.

In the case of excitation by canal-rays of hydrogen, in addition to the atomic and molecular spectra of hydrogen, three groups of lines lying approximately at λ 2870, 2150, 2210 are observed. The lines belong either to silicon or oxygen (or both). OI and SiI have nearly identical spectra in this region. The resolving instrument used is not qualified to allow a definite conclusion as to the emitter. The same lines are also obtained when the excitation is brought about by canal-rays of nitrogen.

Much more interesting is the remarkable change obtained in the intensity distribution of the hydrogen continuum, observed when the canal-rays of hydrogen are used for the excitation. Figs. 1 and 2 give the relative intensity distributions in the continuum here obtained and that observed with canal-rays of hydrogen when care is taken to eliminate the fluorescent light from the quartz window. The relative intensity distribution curve in the former case, shows two distinct maxima in the regions λ 4000 and λ 3200 with a shallow minimum in between the two, at about λ 3600. The maximum at λ 4000 can perhaps be seen with low intensity but the one at λ 3200 or the minimum at λ 3600 are certainly absent in Fig. 2. The fact that, with excitation by canal-rays of nitrogen, only the above three characteristic groups of lines are obtained, without the presence of the continuum shows that quartz



Excitation of quartz by H_2 canal-rays of 8 kV.

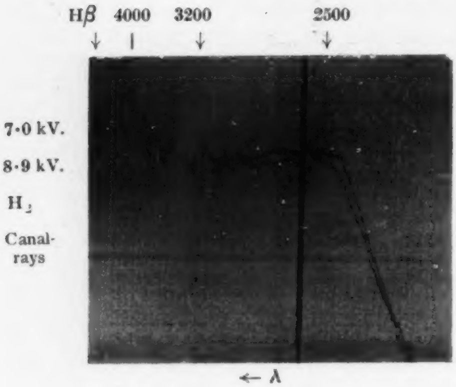


FIG. 2

The pure hydrogen canal-ray spectrum

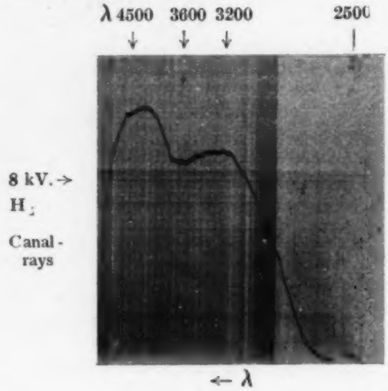


FIG. 1

Excitation of quartz by canal-rays of hydrogen

itself does not emit a continuum, and the continuum observed must therefore be ascribed to hydrogen itself. This conclusion finds some support in the observation of Goldstein[1] that the colour of the fluorescence produced under impact with canal-rays depends on the chemical nature of the canal-rays themselves.

The peculiar change observed in the intensity distribution must therefore be ascribed, either to an overlapping of the usual continuum by some other spectrum characteristic of hydrogen, excited under conditions here obtaining, or to an effect of the type described by Smith[3] brought about by the presence of foreign gases. It may be interesting to note here, that Wien[2] had found a minimum in the intensity distribution of the continuous spectrum emitted by canal-rays of hydrogen at about λ 4000. It is still obscure under what conditions this minimum obtains, for it has been observed only in one other case, by Herzberg,[4] in the case of an electrodeless discharge in hydrogen. The minimum observed in the experiments here described, lies at λ 3600, which is sensibly different from the value given by Wien. There is a continuous spectrum observed by Herzberg and Brasefield[5] extending from roughly H_β to H_γ with a maximum of intensity in between, obtained at extremely low pressures ($\sim$ 0·0005 mm. Hg.). The presence of this spectrum, at the pressures here used (0·01 mm. Hg.) appears somewhat unlikely and secondly an overlapping of the usual molecular spectrum by the Herzberg-Brasefield continuum will not explain the observed intensity distribution. As for the other possibility, *viz.*, the effect of the presence of oxygen and silicon, on the intensity distribution of the continuous spectrum of hydrogen, there are unfortunately no available data on the subject.

The positions of the maxima and the minimum, in the intensity distribution here observed, do not show any appreciable dependence on the energy of the exciting canal-rays (for the range of energies here used). The relative values of the maxima, on the other hand, vary sensibly with the energy.

I take this opportunity to offer my grateful thanks to Prof. Dr. Asundi for his kind interest in the investigation, and to Dr. Nawazish Ali,

Muslim University, Aligarh, for kindly taking the microphotographs.

V. T. Chiplonkar.

Physics Department,
Benares Hindu University,
November 8, 1940.

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1 W. Wien, 'Kenalstrahlen', *Handbuch der Experimental Physik*, 1927, Band **14**, 443.

2 *Ibid.*, p. 693.

3 N. D. Smith, *Phys. Rev.*, 1936, **49**, 345.

4 G. Herzberg, *Ann. d. Physik.*, 1927, **84**, 553.

5 W. Finkelnburg, 'Kontinuierliche Spektren' *Struktur und Eigenschaften der Materie*, Band **20**, Julius Springer, 1938, p. 184.

GRAVIMETRIC DETERMINATION OF MANGANESE WITH 8-HYDROXYQUINOLINE

Berg[1] showed that manganese could be precipitated quantitatively by means of 8-hydroxyquinoline ("Oxine") as a dull yellow crystalline compound with the composition $Mn(C_9H_6ON)_2$, $2H_2O$. The precipitation was carried out either from (1) a neutral or weakly acid solution containing sodium acetate and a small amount of sulphite or hydroxylamine by adding an excess of an alcoholic solution of the reagent, or (2) from a mineral acid solution containing an excess of an acetic acid solution of the reagent by adding dilute ammonia until weakly alkaline. The precipitates obtained by both methods, however, could not be satisfactorily dried to constant weight since at 110° C. drying was very slow and above this temperature appreciable decomposition occurred. The gravimetric determination was, therefore, carried out by Berg (*loc. cit.*) by igniting the precipitate to the oxide, Mn_3O_4 with oxalic acid and weighing.

Raikow and Tischkow[2] showed that the composition of the ignited tetroxide depends on the temperature and the nature of the atmosphere surrounding the precipitate during the ignition. Further the procedure adopted by Berg for the gravimetric determination suffers from the fact that no advantage is taken of the precipitation of manganese as the heavier oxyquinolate molecule.

During the present investigation it was found that the heat stability of the precipitates during drying depended considerably on the method of precipitation. While precipitates obtained by Berg's first method were easily decomposed at temperatures higher than 110° C., those obtained by the second method were quite stable at temperatures as high as 150–170° C. Prolonged drying (20 hours) at 150° C. did not produce any decomposition in a large number of cases studied with amounts of manganese varying from 0·3 to 60 mg. In a few cases, however, a slight superficial discolouration of the precipitates was observed but this was inappreciable even when dealing with the smaller amounts of manganese. It was also found that even this discolouration did not occur if the precipitation was carried out in the presence of a little sulphurous acid. Drying at even a higher temperature (170° C.) showed that the precipitates were quite stable and the discolouration inappreciable. A temperature of 150° C. was, however, considered to be the most suitable for drying. Constant weight of the precipitates was attained in two to three hours at this temperature and the composition of the dried precipitates corresponded to $Mn(C_9H_6ON)_2$ containing 16·03 per cent. manganese.

The influence of large amounts of ammonium chloride, sodium chloride and ammonium oxalate, as occur in the filtrate from "lime and strontia" in rock analysis, on the precipitation of manganese was also studied with a view to adapt the "oxine" method for the precipitation of magnesium and residual manganese in rock analysis. It was found that both manganese and magnesium could be precipitated together quantitatively adopting Berg's second method provided ammonium salts, and oxalic acid which interfered with the precipitation of magnesium as the oxyquinolate, were removed by the nitric acid method.[3,4] The precipitates thus obtained were dried to constant weight at 150° C. and weighed. To determine the manganese in these precipitates, the weighed

precipitate was dissolved in nitric acid (1 : 1), the solution evaporated to dryness in a platinum dish and the organic matter ignited. The residue was dissolved in concentrated nitric acid and the manganese determined colorimetrically by the periodate method. Satisfactory results were obtained for both manganese and magnesium.

The above work was done by the author in collaboration with H. F. Harwood and L. S. Theobald of the Imperial College of Science and Technology, London. Details will be published later.

K. NEELAKANTAM.

Department of Chemistry,
Andhra University,
Waltair,
December 17, 1940.

1 Berg, *Z. anal. Chem.*, 1929, **76**, 191.
2 Raikow and Tischkow, *Chem. Ztg.*, 1911, **35**, 1013.
3 Hillebrand and Lundell, *Applied Inorganic Analysis*, 1929, p. 119.
4 Miller and McLennan, *J. Chem. Soc.*, 1940, 656.

ON THE VELOCITY OF SOUND IN AND CHEMICAL REACTIVITY OF BROMINE AND IODINE

THE velocity of sound in metallic elements has been found to be dependent upon the atomic frequency and the least distance separating the atoms.[1] This least distance between the atoms concerned determines the chemical reactivity and approximates to "critical atomic approach value" for any type of action.[2] The direct formation of bromides and iodides suggest for the 'critical atomic approach' values which may be taken to be equal to the least distance separating the atoms of these two elements. With these values of least atomic distances and author's values of atomic frequencies, attempt may here be made to compute the velocities of sound in these non-metallic elements by applying the author's formula for the case of metals.

Element	Atomic Frequency	Distance of closest approach of atoms	Valency	Constant	S. calc.	S. obs.
Bromine	2·76[4]	1·88[5]	1	10	131·1	135·0
Iodine	2·1[4]	2·12[5]	1	10	113·1	107·7

It would be evident from the above table that the values so obtained are comparable with those observed.[3] It would thus appear that the author's formula for the calculation of velocities of sound in metallic elements may be extended to such calculation at least in two non-metals. Further, there would appear to be a relationship between the velocity of sound in bromine and iodine and the 'critical atomic approach values' for the direct formation of bromides and iodides. So velocity of sound appears to be significant for bromide and iodide formation.

The formula proposed for the calculation of velocity of sound in metallic elements may be represented thus

$$S = L\left\{\left(\frac{1}{2\pi}\sqrt{K}\sqrt{\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\cdot\frac{N}{M}}\right)\times\left(f_2\times f_1\,(V)\,\frac{P}{V_i\times d^{k_1}}\right)\right\}$$

where S is the velocity of sound in metallic elements, L a constant having value 2·54; $\left(\frac{1}{2\pi}\sqrt{K}\sqrt{\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\cdot\frac{N}{M}}\right)$ the atomic frequency[4] and $\left(f_2\times f_1\,(V)\,\frac{P}{V_i\times d^{k_1}}\right)$ the distance of the closest approach of atoms.[5]

In the factors $\left(\frac{1}{2\pi}\sqrt{K}\sqrt{\frac{P-V}{V}\cdot\frac{Ze^2}{r^3}\cdot\frac{N}{M}}\right)$ and $\left[f_2\times f_1\,(V)\,\frac{P}{V_i\times d^{k_1}}\right]$, P represents parachor, V the atomic volume, Z the valency, M atomic weight, e the elementary charge, N Avogadro's number, V the ionisation potential, K and $\sqrt{K}$ constants having the values 0·925 and $0{\cdot}415\times10^{12}$, and $f_2\times f_1$ (V) a constant depending upon valency having the dimension $\frac{M^{1/2}}{L^{\cdot575}\times T}$ which in the present instances takes the value ·615.[5]

In the application of the above formula to obtain the velocities of sound in the two non-metals cited the value of the constant L is to be multiplied by 10.

BINAYENDRA NATH SEN.

Chemistry Department,
Burdwan Raj College,
Burdwan,
October 9, 1940.

[1] Sen, B. N., *Gazzetta*, 1938, **10**, (68), 662.
[2] —, *Proc. National Academy of Science, India*, 1937, **8**, 1, 6.
[3] *International Critical Tables*, **6**, 465.
[4] Sen, B. N., *Journ. Ind. Chem. Soc.*, 1934, **11**, (4), 243.
[5] —, *Gazzetta*, 1938, **10**, (68), 656.

THE MILK CLOTTING ENZYME OF *WITHANIA COAGULANS*

THE fruit of *Withania coagulans* contains an active rennet which can be obtained in highly concentrated form by the following procedure: The partially dried fruits are ground up with water, the extract filtered through paper pulp and the clear solution treated with ammonium sulphate. The precipitate formed at 25 per cent. saturation is discarded as it contains very little activity. The material that separates on further addition of ammonium sulphate to 65 per cent. saturation contains the whole of the enzyme. The precipitate is separated by centrifuging, redissolved in water, and the solution after being dialysed free from ammonium sulphate, is filtered through paper pulp. Ten volumes of acetone are now added, the precipitate is centrifuged, washed with small quantities of acetone and dried in the desiccator. 100 g. fruit pulp usually yield about 3 g. of enzyme. The material thus obtained is a brownish white powder which has a milk coagulating action nearly 30 times that of the original *fruit pulp*, 0·125 g. of powder being capable of bringing about the coagulation of 1 litre of fresh milk at 30° in 30 minutes. The preparation is quite stable and retains its activity unimpaired on keeping at room temperature for weeks.

For determination of activity comparison was made with a standard pepsin solution prepared according to Rona[1] (1931) the substrate being either freshly boiled milk (Michaelis and Rothstein)[2] or milk powder (Rona and Gabbe).[3] The optimum temperature for the action of enzyme is 48°. Three minutes at 90° completely destroys it, the destruction being 40 per cent. at 70° and 75 per cent. at 80°. The main properties of the enzyme from *Withania coagulans* as compared to those of other well-known milk clotting enzymes are given in the following table.

	Enzyme from *Withania coagulans*	Papain	Pepsin
ACTIVITY (Quantity of enzyme for clotting 1 lit. of milk in 30 min.) ..	125 mg.	31 mg.	3·2 mg.
Optimum Temperature	48°	87°	37°
Proteolytic action .	—	+	+

It will be seen that the preparation from *Withania coagulans* is only about ¼ as active as papain and 1/40 as active as pepsin. In practical cheese making however it is doubtful if papain can be utilised as a substitute for gastric rennet on account of the bitter flavour it imparts to the clot even in minute concentration. The texture of the clot formed is dependent on the time taken which is in turn determined by the quantity of enzyme and the temperature. A firm compact clot is obtained when at the optimum temperature of 48° sufficient enzyme is added to give a clot in about 20 minutes.

A finding of considerable theoretical importance is the observation that the *Withania coagulans* enzyme has no proteolytic action, no increase in amino nitrogen being observed when it is allowed to act for a week on gelatin solution at various pH's. On account of the difficulty of separating gastric rennet from pepsin the individuality of the former has often been questioned. Further in discussions on the mechanism of clot formation a proteolytic fission

of the casein molecule prior to coagulation has frequently been postulated (*cf.* Oppenheimer).[4] In the enzyme now obtained from *Withania coagulans* we have for the first time a preparation which is entirely devoid of proteolytic activity and which therefore provides clear proof of the independence of the process of coagulation to hydrolytic cleavage of casein.

The author's thanks are due to Mr. Zal R. Kothavalla, Imperial Dairy Expert, Bangalore, who suggested the research and supplied the material and to Prof. M. Damodaran for his interest in the work.

(MISS) K. M. YESHODA.

University Biochemical Laboratory,
Madras,
December 23, 1940.

[1] Rona, *Praktikum der physiologischen chemie*, 1931, **1**, 276.
[2] Michaelis and Rothstein, *Biochem. Zeit.*, 1920, **105**, 60.
[3] Rona and Gabbe, *Ibid.*, 1922, **134**, 39.
[4] Oppenheimer, *Die Fermente*, 1926, **1**, 978.

CATALYSIS BY ASCORBIC ACID

DURING the course of our work on the role of ascorbic acid in physiological processes and the cause of its stability in plant and animal tissues we have found that it catalyses the reduction of silver chloride by sodium sulphite.

The experiments were conducted in brown bottles and silver chloride was formed *in situ* by adding to each bottle 10 ml. of 0·1N silver nitrate and 10 ml. of 0·1N potassium chloride solution. The requisite volumes of sodium sulphite solution and ascorbic acid solution were then added, followed by enough distilled water to make up the total volume to 50 ml. After three to three and half hours, the contents of each bottle were poured through a filter (Whatman No. 42, for fine precipitates). The residue on the filter was carefully washed until free from the soluble salts. The funnel with the filter is then put over a 250 ml. volumetric flask and the residue on the filter treated with 1 : 1 dilute analytical nitric acid. The corresponding brown bottle was also treated similarly and the liquid poured on the filter. The treatment is repeated three times to ensure complete solution of any metallic silver formed by reduction. It is well known that silver chloride does not dissolve in 1 : 1 nitric acid. The filtrate in the 250 ml. flask was made up to the mark, and the amount of silver in an aliquot portion estimated volumetrically by titration with standard potassium thiocyanate solution, using ferric alum as the indicator.

Under these experimental conditions we have found that sodium sulphite does not reduce silver chloride, while ascorbic acid does so readily. Further we made the interesting observation that in the presence of sodium sulphite a given amount of ascorbic acid produces a much larger reduction of the silver halide than when it is alone.

TABLE I

5 Milligrammes of ascorbic acid

Volume of sodium sulphite solution 0·025 Molar	Amount of AgCl in milligrammes Ag	Milligrammes Ag obtained by reduction in 3½ hours
0	107·9	2·88
5 ml.	107·9	6·26
10 ml.	107·9	9·04
15 ml.	107·9	9·71

The results indicate that ascorbic acid induces the reduction of silver chloride by sodium sulphite. The following table shows the influence of the concentration of the inductor, namely ascorbic acid on the rate of reduction, keeping the concentration of sodium sulphite at a constant but fairly high value.

TABLE II

Concentration of sodium sulphite 0·05 Molar

Amount of ascorbic acid	Amount of AgCl in milligrammes Ag	Milligrammes Ag obtained by reduction in 3 hours
5 milligrammes	107·9	7·08
10 ,,	107·9	12·18
15 ,,	107·9	17·00

It will be seen from the above results that the rate of the induced oxidation increases with increasing concentration of the inductor.

The mechanism of this induced oxidation may be as follows:—

$$AH_2 + 2\,AgCl \rightarrow 2Ag + 2\,HCl + A$$

Ascorbic acid

$$A + Na_2SO_3 + H_2O \rightarrow AH_2 + Na_2SO_4$$

Dehydroascorbic acid

This is similar to the mechanism suggested by Pandalai and Gopala Rao[1] for the reaction between silver chloride and sodium sulphite induced by hydroquinone or metol.

In order to obtain confirmation of this mechanism we prepared dehydro-ascorbic acid by oxidation of the vitamin in aqueous solution with Norit Charcoal and found that the oxidized form thus prepared is incapable of reducing silver chloride by itself, while it can do so in the presence of sodium sulphite.

It will be of interest in this connection that Hopkins and Morgan,[2] Borsook and Jeffries[3] found that glutathione reduces dehydro-ascorbic acid to ascorbic acid.

$$2G\text{-}SH + A \rightarrow AH_2 + G\text{-}S\text{-}S\text{-}G$$

Glutathione

It is by this mechanism that Hopkins and Morgan explained the protection of vitamin C from oxidation in tissues.

G. Gopala Rao.
T. V. Subba Rao.

Andhra University,
Waltair,
November 15, 1940.

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[1] *Zeit. Anorg. Chemie*, 1933, **215**, 23.
[2] *Biochem. J.*, 1936, **30**, 1446.
[3] Borsook and Jeffries, *Science*, 1936, **83**, 397.

STRAINS OF *COLLETOTRICHUM FALCATUM* WENT

Colletotrichum falcatum Went is widely known as the causal organism of red rot of sugarcane, a disease present wherever sugarcane is grown. While surveying the red rot flora in the cane-growing tracts of America, Abbott[1] came across differences in the cultural characters of the parasite. He could distinguish two principal races among his collection which for convenience he designated as light and dark races. He found also that these two types varied in their virulence.

Red rot broke out in an epidemic form in North Bihar during 1939–40 season and did considerable damage to the crop. Specimens of diseased canes were obtained from several localities and cultures taken from affected tissues adopting a standard method of culturing in all cases. Differences in the morphology of the cultures obtained could be noticed in one month when two distinct types and an intermediate form could be distinguished. The following are the descriptions:

Type A.—The colony of this type is cottony and floccose in texture, white in colour during the first two weeks assuming a very light tint of gray with age. Slimy pink masses of conidia are absent in this culture.

Type B.—The texture of the colony is loose and silky. For the first two weeks the aerial mycelium is almost translucent and on account of this character it is difficult to define the actual shade of gray to which it belongs even with the help of Ridgway.[2] Abundant dark pseudopycnidial masses are to be seen in the aerial mycelium while an enormous number of slimy masses of conidia are produced on the surface of the medium; the slimy masses are of salmon colour (Ridgway, *loc. cit.*). Old cultures exhibit a more compact texture with the loose silky mycelium more or less disappearing with age. On oatmeal agar this grows much faster than Type A.

Type C.—The colony of this type has a compact velvetty texture and is darker than Type A. Conidia are produced in pink masses sparingly with a tendency to confine themselves to the margins of the media. This is perhaps an intermediate form of A and B.

In certain cases during the tissue-culture examination two types of the parasite were met with and no antagonism was observed between the races. This is in agreement with the findings of Abbott.[1]

In the absence of actual specimens of Abbott's light and dark races the three types met with in Bihar red rot flora cannot be designated in terms of Abbott's descriptions but Types A and C seem to answer closely to the light and dark races respectively except that the former does not appear to produce abundant pink masses of conidia. The culture sent by Dr. Mundkur to America for comparison belonged to the dark race according to Abbott.[1]

A preliminary test was conducted to see whether the morphologic differences noticed could be correlated with physiologic differences also. The rates of spread of the two races in 3-eye setts of four varieties, Co 213, 299, 421 and B. 04 were taken as a basis. The setts were inoculated in the middle internode with 8 days' old cultures of Types A and B and kept at room temperature (30–32° C.) for a fortnight. The length of spread was measured and it was found that the linear spread was equal on both sides of the point of inoculation. The organism spread along the entire width in all cases and hence this feature was not taken into account for measuring the index of virulence.

The index was arrived at by dividing the length of the sett by the length of the spread of the organism. The average spread is tabulated below.

TABLE I

Variety	Index of Virulence	
	Type A	Type B
Co 213	3·71	1·96
Co 299	1·49	2·52
Co 421	2·08	2·95
B. 0·4	1·37	4·35

The two races appear to vary as regards their rate of spread within the sett and the variety of the host also influences the rate of spread. This index of virulence, however, is not an indication of the varietal susceptibility which should also take into account the entry of the parasite.

The relation between the specialisation exhibited by *Colletotrichum falcatum* Went and the epidemic outbreak of red rot in North Bihar is under investigation.

S. A. RAFAY.
S. Y. PADMANABHAN.

Mycology Section,
Sugarcane Research Station,
Pusa, Bihar,
August 18, 1940.

[1] Abbott. E. V., *Tech. Bul.*, 641, *U. S. Dept. Agri.*, 1938.

[2] Ridgway, R., *Colour Standards and Colour Nomenclature*, Washington, 1912.

PRODUCTION OF FRUIT-BODIES OF *AGARICEUS POLYPORUS* BERK. IN ARTIFICIAL CULTURE

Polyporus agariceus Berk. is a saprophyte, usually growing on prostrate logs or dead branches. Bose[1] reported it from Barkuda Islands, Orissa with *P. arcularius* (Batsch) Fries and *Favolus ciliaris* Mont. given as synonyms. The species has been collected from Darjeeling (Hooker f.), Mussoorie (Gollan), Ceylon and several other parts of the world. Though of rare occurrence, it has also been collected on several occasions from Behala, Ballygunj and Shyambazar in the suburbs of Calcutta (Bose, Banerjee).

While making an extensive cultural study of some of the wood-rotting fungi common in Bengal, a fresh sporophore of *Polyporus agariceus* was collected in October, 1940, from Shyambazar, Calcutta, growing saprophytically on logs of *Shorea robusta* (sal). Spore-deposits were taken immediately on sterile agar plates from which several polyporus cultures were made in potato-dextrose agar and kept under different conditions of light and temperature. In all cases germination of spores started within 24 hours.

On the 10th day of inoculation the whole surface of the slant was covered with a felty growth which condensed irregularly making

Fig. 1. Cultures showing gradual development of the fruit body of *P. agaricus* Berk. (Nat. size)

Fig. 2. Pileus magnified to show the pore-mouths

the surface of the slant uneven. The condensed portion became light cinnamon drab to cinnamon drab in colour (Ridgways's Color Standards and Color Nomenclature). The first culture took 23 days to fructify at room temperature and in diffused light, but in subsequent subcultures under the same conditions the period was reduced to one week only. A total period of 4 to 10 days was required for the complete development of the fructifications. It first appears as a small protuberance which goes on growing in length for about 3 to 9 days and terminates in a distinct flattened knob which ultimately expands to form a typical, small, yellowish-brown, umbilicate pileus during the next 24 hours. The margin of the fully expanded pileus is densely clothed with very minute hairs. Pore-mouths, though small, are distinctly hexagonal and slightly projected. Sections of pore-tube show well-developed hymenium with clavate basidia (about 12 to $17\mu \times 3$ to 4μ) each with 4 long sterigmata terminated by white, oval spores (about 6 to $8\mu \times 2$ to 3μ).

Similar fructifications were also obtained on the same medium when sub-cultures were kept in a cold room (22° C.) in diffused light within 14 days after inoculation.

In all cases it was observed that the stalk of the sporophore was negatively geotropic during its growth but became positively phototropic after the formation of the flattened knob. The phototropic curvature of the stipe takes place a little below the pileus. In complete darkness the fungus fructifies but the rate of elongation as well as the length of the stipe is greatly increased and the size of the pileus is slightly reduced.

Detailed cultural studies are now in progress, the results of which will be communicated elsewhere.

The work has been conducted under the guidance of Mr. S. N. Banerjee and is still being continued. My sincerest thanks are due to him for this. I also take this opportunity in expressing my indebtedness to Prof. S. P. Agharkar for his kindness in affording me

facilities in various ways during the progress of this investigation.

MADHUSUDAN CHAKRABARTY.

Botanical Laboratory,
Calcutta University,
December 4, 1940.

[1] Bose, S. R., *Polyporaceae of Bengal*, **9**; *Jr. Dept. Sc. C. U.*, **9**, p. 36.

CHROMOSOMES OF *RICCIA HIMALAYENSIS* St. (Ms.)

STUDY of the differentiation of sex in plants and animals has always fascinated biologists to look for deeper causes underlying this great morphological fact; and, one of the most widely accepted explanations of this phenomenon is the sex-chromosome mechanism. Towards the beginning of the present century the sex-chromosome was discovered in animals, particularly in the Insecta, by workers like McClung[1] (1902), Wilson[2] (1904) and others; but not till 1917 was it found in plants, when Allen[3] (1917) first discovered it in a Bryophyte, *Sphærocarpus donnellii*. Subsequent researches showed that it occurs in plants belonging to other groups also, *e.g.*, in *Rumex, Humulus, Cannabis*, etc. Many bryophytic genera were also investigated with a hope of finding it in them, and it was found in some of them too, *e.g.*, in *Pallavicinia;* but with the growing mass of information about the cytology of liverworts, it became evident that a heteromorphic chromosome as one finds in *Sphærocarpus* is not of universal occurrence in them. For example Showalter[4] (1921) did not find it at all in *Conocephalus*; whereas the reports regarding its occurrence in species of *Riccia* like *R. Curtisii*[5] or *R. Bischoffi* were conflicting.

A careful consideration of the various Indian liverworts described by the late Prof. Kashyap[6] (1915, 1916, 1929, 1932) does suggest a possibility of finding a sex-chromosome in some of them at least; but unfortunately our knowledge of the cytology of these forms, except perhaps that of the Codoniaceæ worked out by Mehra[7] (1938), is very meagre. Even the commonest genera like *Riccia* or *Marchantia* have not been worked out thoroughly. An investigation, therefore, of some of the species of *Riccia* found in this part of the country was undertaken and the results obtained in one of them, namely, *Riccia himalayensis*,[8] are given below.

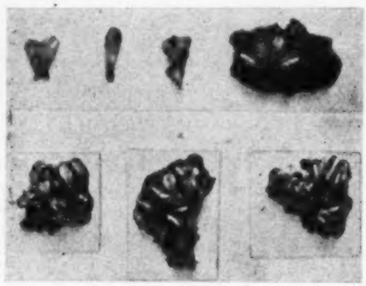

FIG. 1

Riccia himalayensis St. (Ms.) ⅔ Natural size

The material for the present investigation was collected in the vicinity of Ahmedabad and Poona and fixed in Allen-Bouin, Flemming's strong fluid, Navaschin's and other fixatives. It was cut by the usual paraffin or Dioxane method and stained with Heidenhain's Hæmatoxylin. Many clear equatorial plates were obtained in the cells of young developing antheridia and some in the meristematic cells on the dorsal surface near the growing point of the thallus, but not in the cells undergoing sporogenesis. This is largely due to the fact that the spore-mother-cells undergoing tetrad divisions are full of oil globules and granular cytoplasm which render the achromatic spindle obscure; and this has been the experience of many other workers also.[9]

Fig. 1 is a photograph of the plants the chromosomes of which have been determined and are shown in Fig. 2. Fig. 2 *a* and *b* show them in antherids and Fig. 2 *c* shows them in a meristematic cell of the thallus cut slightly obliquely. It is evident that there are eight chromosomes in the haploid nucleus of the species. Seven of them are slender, elongated, not straight, but bent in crooked forms and

consequently irregular in outline. The eighth element is much smaller than the rest and is often elusive on account of its small size and

FIG. 2.

Riccia himalayensis St. (Ms.). Chromosomes: (*a*) and (*b*) Polar views of equatorial plates in antherids ; (*c*) in a meristematic cell of the thallus. × 1200.

dot-like form. This is perhaps the reason why authors like Beer[10] (1906) have said that the reduced number of chromosomes in *Riccia glauca* is either seven or eight. In our preparations also we did get plates showing only seven chromosomes but in other clear metaphase plates the occurrence of the eighth element was unmistakable. The attachment of the seven large chromosomes is atelomitic and that of the small eighth element telomitic. There is no heterochromosome in this species; and the diploid number of chromosomes seems to be 16. It is interesting to note that this very number is found in two other species studied by Lorbeer[11] (1934) and Siler[12] (1934), namely in *Riccia fluitans* and *Riccia donnellii*, whereas the great majority of the species like *Riccia crystallina*, *Riccia sorocarpa*, *Riccia arvensis* have only 8 chromosomes in the diploid condition. Evidently *Riccia himalayensis* is a diploid species as contrasted with species like *Riccia crystallina* which have the basic eight number. This is perfectly in accordance with Heitz's[13] (1927) observation that 'the liverworts with 8 or 9 chromosomes are predominantly diœcious, whereas those with 16 or 18 or other multiples of the basic number are predominantly hermaphroditic'.

Both the authors express their great appreciation of the helpful guidance they received from Prof. J. J. Asana, M.A. (Cantab.), in course of this investigation and wish to express their sense of gratitude to him.

T. S. MAHABALE.
G. H. GORJI.

Biology Department,
Gujarat College,
Ahmedabad,
December 14, 1940.

[1] McClung, C. E., *Biol. Bull.*, 1902, **3**, 43.
[2] Wilson, E. B., *Science*, 1905, **20**, 564.
[3] Allen, C. E., *Ibid.*, 1917, **46**, 466.
[4] Showalter, A. M., *Bot. Gaz.*, 1921, **72**, 245–49.
[5] McAllister, F., *Bull. Torrey, Bot. Club.*, 1928, **55**.
[6] Kashyap, S. R., *New Phytol.*, 1914, **13**, 206, 226 ; *Ibid.*, 1915, **14**, 1 and 308 ; *Journ. Bom. Nat. Hist. Soc.*, 1917, **24**, 343 ; "Liverworts of the Western Himalayas and the Punjab Plain," Part I, 1929 and Part II in collaboration with R. S. Chopra, 1932.
[7] Mehra, P. N., *Proc. Ind. Acad. Sci.*, 1938, **8**, 1.
[8] This species is perhaps synonymous with *Riccia discolor* L. et L. (*Vide* Kashyap, *New Phytol.*, 1915, **14**, 18 ; see also *Journ. Bom. Nat. Hist. Soc.*, 1917, **24**, 349. A somewhat similar opinion about this species has been expressed by Dr. S. K. Pande of the University of Lucknow, in a letter to the senior author (T. S. M.) dated 29th October 1940.
[9] See Campbell, D. H., *Mosses and Ferns* (3rd Ed.), 1918, p. 34 ; see also Pande, S. K., *Journ. Ind. Bot. Soc.*, 1933, **12**, 117.
[10] Beer, R., *Ann. Bot.*, 1906, **20**, 288.
[11] Lorbeer, G., *Jahrb. wiss. Bot.*, 1934, **80**, 565.
[12] Siler, M. B., *Proc. Nat. Acad. Sci.*, 1934, **20**, 603.
[13] Heitz, E., *Abhandl. Naturwiss. ver. Hamburg*, 1927, **21**, 48.

SOIL ALGÆ OF LAHORE

FOR sometime past effort has been made to study the Algal flora of some of the representative soils from Lahore with particular attention to record, if possible, some of the new forms not already reported to be occurring in the soil. Accordingly three types of surface soils, namely,

garden, field and grass soils were taken and portions of these dissolved in Detmer and Bristol culture solutions. The flasks were put in the green house and after about a fortnight onwards different forms of Algæ which appeared were studied and recorded. The material was fixed in 4 per cent. formalin in test tubes for future work. Permanent slides were made in pure glycerine.

Myxophyceæ: A number of species of Oscillatoria and Lynbgya have been described. One species of Oscillatoria seems to be new.

Chlorophyceæ: The interesting forms recorded here are a species of Pandorina and Phacotus. Both these two genera have not been reported before from the soil as far as it has been possible to ascertain from the literature.

Euglenaceæ: Here a new form from the soil, namely, Trachelomonas has been recorded.

Altogether three new genera, namely, Pandorina, Phacotus and Trachelomonas have been recorded from the soil and which have not been reported before. Full details of this work will appear in due course and intensive study of soil Algæ is in progress.

JAGJIWAN SINGH.

Department of Botany,
Government College,
Lahore,
December 5, 1940.

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Bristol, B. M., *Ann. Bot.*, 1920, **34**; *New Phytologist*, 1919-20, 18 & 19.

A NOTE ON THE DEVELOPMENT OF THE FEMALE GAMETOPHYTE IN *ABROMA AUGUSTA* L. AND *PENTAPETES PHOENICEA* L.

Abroma augusta and *Pentapetes phœnicea* are both members of the family Sterculiaceæ. The former is commonly cultivated for its medicinal importance while the latter grows as weed in Bengal during the monsoon.

Literature on the embryology of the family Sterculiaceæ is meagre. Sharma[1] has referred to the relevant literature on the subject and recorded his observations on gametogenesis in three species in an earlier issue of this *Journal*.

The present investigation shows that the archesporial cell is hypodermal in origin in both the plants studied. It cuts off a parietal cell and then functions as the megaspore mother cell. The megaspore mother cell is pushed considerably inwards within the nucellus due to the division of the overlying cells. Two megaspore mother cells lying side by side have been observed in *Abroma augusta*. The reduction division is normal and a linear tetrad of megaspores is produced in both the plants, but in *Abroma augusta* some "T-shaped" tetrads have also been observed. The chalazal megaspore becomes functional in every instance. The usual course of development follows and a normal eight-nucleate embryo-sac is produced. In *Abroma augusta*, however, two binucleate embryo-sacs have been observed to lie side by side. It appears that this has resulted from the activity of the second megaspore mother cell. The mature embryo-sac shows the normal organization but the antipodals are ephemeral. The ovules have two integuments and the nucellus is completely enclosed by these.

I. BANERJI.

Department of Botany,
Calcutta University,
January 2, 1941.

[1] Sharma, Y. M. L., *Curr. Sci.*, 1938, **7**, 284.

PHYSIOLOGY OF POLLINATION IN ORCHIDACEAE

IN Orchidaceæ, the stimulus of pollination is necessary not only for the continued development of the ovary but also for the initiation of the ovules in several species. Normally pollination shortens the life of the blossom and brings about changes in the colour of the perianth. The gynostegium enlarges and the ovary is stimulated to grow into a fruit. These

are some of the changes seen in the flowers as the result of the stimulus of pollination.

In the absence of pollination the life of the blossom continues longer, the perianth remains fresh and there is no growth of the gynostegium and the ovary is arrested in its growth to form a fruit. After a period the flowers may wither away or remain on the plant ultimately drying up.

Fitting[1] observed the growth response of the gynostegium and of the ovary of several orchids on the application of dead pollinia to their stigma. Laibach,[2] Morita[3] and others experimented on the growth responses of the ovary, to the application of dead pollinia, foreign pollen and pollen extracts to the stigma. The results were sometimes positive and sometimes negative. As the result of a series of investigations by them, the existence of growth promoting substances such as auxins, hormones, etc., were shown to be present in the pollen, pollen extracts, pollen tubes, in the wall of the ovary and also in the placental tissue of orchids. Fitting further believed that the substance extracted contained no nitrogen and that it was not an enzyme.

Gustafson[4] has induced parthenocarpy in several plants belonging to diverse groups of flowering plants, by the application of pollen extracts and other growth promoting chemicals. During the past few years a number of organic compounds which stimulate the growth of plants have been isolated. But no satisfactory explanation of the mode of action of many of these growth-promoting substances in the plant body is to be found in the literature.

Laibach[2] has investigated the nature of the substance obtained from the pollinia of orchid flowers and has found that it not only caused swelling in the gynostegium of orchids but also caused a stretching of the coleoptile of oats. So Laibach is of opinion that the hormone from the pollinia and the growth substance such as auxins are either identical or closely related.

The investigations of Boysen Jensen[5] clearly show that auxins promote growth by influencing the turgor of the cells there by bringing about stretching of the cell wall. Later new material will be incorporated in the stretched cell wall, thus bringing about permanent increase in size and hence growth.

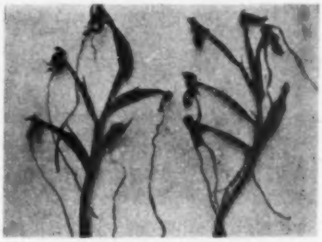

FIG. 1

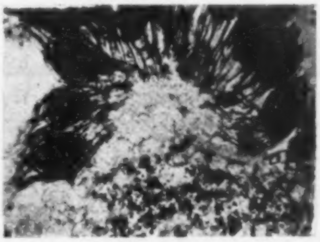

FIG. 2

FIG. 3

Flowering shoot of *Habenaria longicalcarata* showing the pollinated and the unpollinated flowers. Both are 40 days old from the time of the opening of the flowers. The pollinated ones have developed into fruits. ¼ Nat. size.

Transverse Section of part of the ovary of the pollinated flower showing the starch grains, strained with iodine in the placental tissue and the well-developed ovules with the embryos. 40 days old, × 80.

Armstrong and Armstrong[6] are of opinion that the main effect produced by hormones when they gain entry into the living cell is the stimulation of enzymic activity which influences the metabolism in plants and animals.

The results obtained by the work of the author appear to be highly suggestive and throw more light on this problem of stimulation in the physiology of pollination in Orchidaceæ and the mechanism by which the pollen hormone promotes growth of the orchid ovary. A brief note about it is given here with particular reference to *Habenaria longicalcarata* (Rich.). Two other species of *Habenaria* and one of *Ipsea* have been studied and the results confirm the observations made on *Habenaria longicalcarata*.

When pollinated the ovary of *Habenaria* grows into a fruit and becomes much bigger than the ovary of the flower which is not pollinated. Superficially much difference cannot be made out between the pollinated and the unpollinated ovaries except in their size (photograph 1). The ovary of the unpollinated flower though forty days old and of the same age as the ovary of the pollinated shown in the above photograph, remains rich green in colour but it is inhibited in its further growth.

Histological details show that in the pollinated ovary (micro-photograph 2) there is an abundance of starch in the inner wall cells of the ovary and particularly it is rich in the placental tissue where there are a large number of leucoplasts in which starch is elaborated from the simpler carbohydrates derived from the chloroplasts. In the outer wall cells chloroplasts can be made out and the stomata in the epidermis are very efficient. The ovules show normal development since they are well supplied with the plastic nutritive material synthesized in the wall of the ovary.

In the unpollinated ovary (photo-micrograph 3) absence of starch is conspicuous and naturally associated with it are the undeveloped ovules. The chloroplasts, the leucoplasts and the stomata though apparently normal looking are not functional. They seem to remain inhibited from their normal activity.

These facts clearly indicate the mode of action of the growth-promoting substance or pollen hormone present in the pollinia of *Habenaria*. This hormone stimulates the plastids to synthetic activity by its enzymic action as a result of which plastic substances in the form of carbohydrates are synthesized in the wall of the ovary thus providing special nutrition not only for the continued growth of the ovary but also for the normal differentiation and development of the ovules.

Laibach is of opinion that the pollen hormone from the pollinia of orchid, which he investigated, and the other growth-promoting substances like auxins are either identical or closely related. How far this view holds good in the case of *Habenaria* is under investigation.

The author is indebted to Dr. M. A. Sampathkumaran, M.A., Ph.D., Professor of Botany, for many a help given during the course of this work.

K. N. Seshagiriah.

Department of Botany,
Central College,
Bangalore,
October 20, 1940.

[1] Fitting, H., *Zeitschr. Bot.*, 1909, **1**, 1-86.
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[3] Morita, K., *Bot. Mag.*, 1918, **32**, 39-52.
[4] Gustafson, F. G., *Amer. Jour. of Bot.*, 1937, **24**, No. 2.
[5] Boysen Jensen, P., *Growth Hormones in Plants*, McGraw Hill Book Company, 1936.
[6] Armstrong, H. E., and Armstrong, E. F., *Annals of Botany*, 1911, **25**.

SPEARFISH ATTACKS AN OTTER BOARD

Various instances of attacks of swordfish and spearfishes on vessels have been recorded in a comprehensive paper by Gudger on "Alleged Pugnacity of Swordfish and Spearfishes".[1]

In this paper there is no record of any attack off Colombo. During minesweeping exercises of "M. S. Goliath" under the command of one of us (M.M.) off Colombo in August 1940 one of the otter boards (teak plank of 2" thickness) was pierced through by a *Makaira indicus* which left behind its sword attached to the board. The accompanying photographs (Figs. 1 and 2) by Lieut. Engineer A. Smith (Fig. 3

by S. M. Mohamed) show the various aspects of the sword and the otter board.

FIG. 1

The weapon *in situ*

FIG. 2

The damage caused to the timber

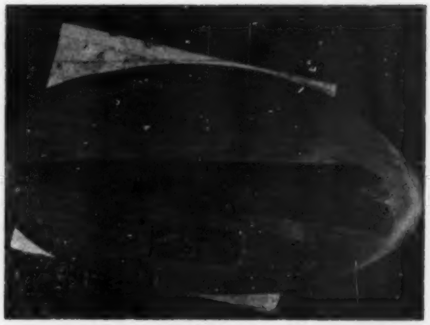

FIG. 3

The detached sword (16·1 inches) mounted on board and now placed in Head-quarters of the Ceylon Naval Volunteer Force, Colombo

The attack took place when both the fish and the vessel were moving in the same direction. There was no shoal of fish following this vessel.

C. AMIRTHALINGAM.
M. MONNINGTON.

Department of Fisheries,
Ceylon Naval Volunteer Force,
Colombo,

December 16, 1940.

[1] *Memoir of the Royal Asiatic Society of Bengal*, 1940, 2, 215.

OUR EARTH LORE

Twice two milliard years before
Was born our Earth of fiery core;
Her infant days she suffered in vain
From burning bowels and colic pain.

For countless eons she wept in woes
And groaned, uncared, in anguished throes;
In time, hardened to chronic case
Endured she, certes, with stony face.

Her fevered core when turned to cool
Her sweat gathered in liquid pool;
In denting thus the face of Earth
These pools attained the ocean girth.

The elements fought with craggy flanks,
The rolling waves—their rocky banks;
They pounded both with powerful hands
And ground the rocks to myriad sands.

The shattered sands were whipped by waves—
In beetling cliffs, to cut dark caves;
To rush frenzied with ruthless mind,
Like maddened fiends, to mow their kind.

The hurling brooks hewed hilly-heads
And swept the clipt to ocean's ledge;
Their loads they laid in sorted beds,
Which rose later as mountain wedge.

Remained the Earth in single state
For a thousand million years, un-mate;
The smallest lives in jellied cells
Then came to crowd her ocean wells.

The land and lakes and floating cells
Were all which hailed that infant Earth;
No bouncing beasts, no flowering dells—
To rouse her face to smiles of mirth.

The weathering rage when waned a while,
The Crust cooled down to breathe a bit;
Rose then the lives in rank and file
To crowd Earth's seas then rendered fit.

Those diverse creatures, few backboned,
Did reign supreme in lake and land;
The fish and coral and three lobed crab
Out-filled those seas of old world drab.

Arose on wane of first flush life,
Which stretched in years to crores fifty,
The flowerless plants, in species rife,
And pristine, Saurian souls plenty.

Those flowerless ferns and equisitales,
Buried unwept in watery wealds,—
For ages hid in Pluto's vales,
Saw light of day as rock coal fields.

The land did groan with reptiles' reign
Through Jura's, Trias, and Chalk-age day;
Those monstrous beasts with meagre brain
Did roam and fight in spined array.

These bulky beasts of mid-life band,
Like mounts alive and dancing jig,
Hopped uncouth that dismal land
Unknown of man or small or big.

Some loathsome monsters reached such length
Their craning necks brushed moon from earth—
The tallest man beside that gang
Would look like Gulliver in Brobdingnag.

Their hideous howls were heard afar,
Their clashing dins awoke the dead,
As they bit and cut and rent in war
To pick the carrion which each one bled.

With Saurian sway the world did groan
For a hundred million years on end;
Our Earth then shook with ireful frown
And hurled the giants to direful end.

The Earth set out to heave a change
Of land and sea of mid-life age;
To raise creatures of varied range
To lead to those of Recent age.

Then Gondwan land convulsed in grief,
In molten tears its face did sear;
The Central sea did break, in brief,
Its bed to lift in mountain tier.

Those lifted mounts looked down on Ind
Of sylvan glades and monsoon wind;
The hairy mammoth and ungulate roan
Roamed these vales of sea-lift zone.

Arose varied the suckling brands
And fragrant trees of flowering kinds—
To fill the world in several lands
And wait advent of ruling minds.

Our Earth bethought of tailless one
To rule her world with erect mien,
She tried some apes and ape-like men
Of Piltdown, Peking, and Rhodesian brain.

Evolved at last the present man
With filtered blood from varied spine,
To live his life of ephemeral span—
A speck of dust in endless line.

The developed man of present race
May die away in coming days;
Lives come and go on Earth's surface
Like flecks of foam on ocean waves.

Whither, oh! whither does all this legend lead?
Does Earth evolve in heavenly ways
And fill her world with angel race,
Or shatters she like Rupert's drops
And end with grumbling, grabbing, human crops?

R. R. B.

REVIEWS

The Course of Evolution by Differentiation or Divergent Mutation rather than by Selection. By J. C. Willis. (Cambridge University Press, London), 1940. Pp. viii + 205. Price 12*sh*. 6*d*.

Natural selection as envisaged by Darwin supplied the mechanism through which it was possible to explain the course of Organic Evolution. Owing to the familiarity of the working of this mechanism it soon gained so great a footing as to enable the theory of Organic Evolution to be established in a firm and almost unassailable position. Since about the beginning of the twentieth century, however, the adequacy of this mechanism has been definitely questioned, and the author of the work under review, Dr. J. C. Willis, though trained in the strictest Darwinian School, began, as a result of his studies on tropical vegetation, to doubt its adequacy. According to him, Natural Selection, though an important factor in the Survival of the Fittest, does not offer either a satisfactory or the necessary explanation for Evolution. Since the last 35 years or so he has, therefore, been working "to find some definite laws underlying the welter of facts in distribution" of plants. The discovery of the "Hollow Curve" formed by the numbers of species in the genera of plants in the Ceylon flora in 1912 has been found by him to be of universal occurrence both in floras and faunas. This study led to the development in 1922 of his Theory of Differentiation which is associated with Age and Area, and according to which while large and "successful" genera are the oldest, the small and local ones are generally the youngest. Further there appears to be no special adaptational reason for the size or spreading of these genera. This theme was developed in the author's work *Age and Area*, but as it was a flat contradiction of the theory of gradual adaptation, it was not generally accepted by the evolutionists.

In the work under review the author describes in fair detail his "Hollow Curve", Mutation, Adaptation, Isolation, Differentiation and Divergences of Variation, and after discussing in the light of the rival theories a number of Test Cases under the headings Numerical, Morphological, Taxonomic, and Geographical Distribution, concludes that "the process of evolution appears not to be a matter of natural selection of chance variations of adaptational value. Rather it is working upon some definite law that we do not yet comprehend".

This highly suggestive and thought-provoking work is a welcome addition to the literature on Evolution, and biologists will look forward to the publication of the author's projected work on Distribution in which he proposes to deal more fully with this aspect of the subject. B. P.

The Microscope. By R. M. Allen. (Chapman & Hall, Ltd., London), 1940. Pp. viii + 286. Price 15*sh*.

In view of the relatively small number of works dealing with microscope in the English language this up-to-date work by a competent authority will be welcomed by all students of microscopy. The work is devoted to the theory and manipulation of an instrument, the uses of which have within recent years extended beyond all belief. A practical treatise on the subject for people who may not be able to understand the advanced mathematics of the optical science was, therefore, an urgent desideratum. In the work under review the author deals with the subject in a simple and easily understandable language, omitting all but the essential formulæ, but without sacrificing any important details. It would be impossible in a monograph of even twice the size to deal adequately with the multifarious phases of micro-technique, but in 7 chapters the author has succeeded in dealing with all important aspects, starting with an Historical Introduction, and passing on from Optical Principles of the Microscope, Modern Instruments, Illumination, Testing of Microscope Objectives, Getting the Most out of the Microscope, to, finally, the Preparation of the Material for Microscopical Examination. In addition to numerous illustrations in the text, 17 plates of beautifully executed half-tone reproductions of microphotographs are published to illustrate the variety of microscopic studies. A detailed bibliography of works on General Microscopy, Optical Principles, Older Works on General Microscopy and of the Objects Revealed by the Microscope, the Microscope in Specialized Use, etc., forms an appendix at the end of the work. Special mention must also be made of the very valuable glossary of about 20 pages in which various terms relating to

microscopy, the microscope, and its manipulation are explained in a very clear and concise language. Most of these terms are commonly used by microscopists, but are often a stumbling block to the uninitiated.

The work is beautifully printed, and considering the amount of matter and illustrations, is remarkably cheap at the published price of 15 shillings. B. P.

An Outline of the Mineral Resources of Andhra Desa. By C. Mahadevan, M.A., D.Sc. (Andhra University Series: No. 22, Madras), 1940. Pp. 81. Price As. 8.

Andhra Desa is endowed with an abundance of mineral wealth which is much greater than what is known of any comparable area in the Madras Presidency: the Mica mines of Nellore, the Manganese mines of Sandur, the Anantapur Gold Field and the famous Diamond fields of Golconda—all belong to Andhra Desa. Perhaps not less important is the fact that this country possesses India's best deposits of Asbestos and Barytes, in addition to having a number of other industrial minerals such as Bauxite, Graphite, Limestone, Ochres, etc.

In this "Outline of the Mineral Resources of Andhra Desa" which is based on the Andhra University Extension Lectures delivered by him in December 1936, Dr. Mahadevan introduces the subject with a brief summary of the general geological features of the country,—an introduction which helps the proper appreciation of the diversity of Geological Formations that contain within them a number of valuable minerals. This is followed by a detailed account of the occurrence of all the economically important minerals of the area, together with a large list of references which will prove useful to the prospector. A geological and mineral map of Andhra Desa on a scale of 42 miles to an inch, is also included. A chapter has been devoted to review the production of the principal minerals and to indicate the possibilities of utilizing them for several local industries. The author points out the scope which exists in the preparation of micanite sheets, the production of common salt, and the revival of indigenous iron-smelting by adopting improved appliances,—all of which are stated to be suitable for organization as small-scale cottage industries. He concludes with a strong plea for a thorough exploration of the area by qualified Geologists.

An attempt such as Dr. Mahadevan has made to take stock of the mineral position of Andhra Desa, is well worth following and it is the reviewer's opinion that if similar accounts are furnished in respect of each of the Provincial Units, they would toe the line for evolving a suitable Mineral Policy for India. M. B. R.

Practical Applications of Recent Lac Research. Edited by H. K. Sen. (The Indian Lac Research Institute, Namkum P.O., Ranchi), 1940. Pp. 75. Price Rs. 1–8–0.

This profusely illustrated and intensely practical volume on the practical applications of lac will be welcomed by all those interested in the continued prosperity and stabilisation of this exclusively Indian and time-honoured industry. Various extensions of the field of the application of lac in industry, have been rendered possible through the researches carried out at different centres in India and abroad, and the present volume is intended to promote the establishment of new lac-consuming industries.

This is unusual volume worthy of emulation by other Research Institutes in the country who are carrying on Industrial Research. If only all other institutions in the country could show the way of translating their investigations into commercially exploitable recipes, Indian research workers will, as a whole, earn the gratitude of the country which is on the threshold of a new industrial renaissance. We cannot resist the temptation of suggesting that the *Board of Scientific and Industrial Research* may issue publications of a similar character on the practical applications of the researches sponsored under its auspices. We wish to congratulate Dr. Sen on this commendable and daring venture. M. S.

Power Alcohol, Its Use as Motor Fuel in the United Provinces. By N. G. Chatterjee. (Department of Industries & Commerce, U.P., Allahabad), 1940. Pp. 17. Price Re. 0–2–6.

This pamphlet is a handy introduction to the public of general information about Power Alcohol, synonymous with "Absolute" Alcohol. The manufacture and cost of alcohol and some experiments in other countries of alcohol-petrol mixtures as motor fuel are described. Some tests with Mysore alcohol are outlined showing the volume change on mixing with petrol and comparative distillation ranges of the blends, in which gum formation does not increase, water tolerance is 0·6 to 0·9 per cent. and the Reid vapour pressure rises slightly.

The use of Power Alcohol in the U.P. is, however, nowhere described except some features of a Provincial Act of 1940 to foster the industry when it is permitted to come into existence.

It is of interest to note that in Mysore where the only Absolute Alcohol plant in India has been working, the State Act legislating for compulsory use of a 15 per cent. alcohol-petrol blend has been in force for over a year. This blend has proved a satisfactory fuel. To determine the best blend for the ordinary car and the proper working conditions for other proportions, experiments should be conducted co-ordinating Laboratory and Road tests. The results of such an enquiry by the Mysore Industrial Research Bureau are awaited with interest. Y. K. RAGHUNATHA RAO.

Forest Research in India and Burma, 1938–39. Part I. *The Forest Research Institute, Dehra Dun.* (Manager of Publications, Delhi), 1940. Pp. 111. Price Rs. 2–14–0 or 4*sh.* 9*d.*

This annual publication summarises the work done at the Forest Research Institute, Dehra Dun; its six chapters are prefaced by a general review and followed by four appendices. The problems under investigation at the Institute are, as usual, many and varied and in addition, the report refers to the very large number of enquiries dealt with. The increasing number of such enquiries is attributed to "the impetus to indigenous industry given by the constitutional changes". This may be; at the same time, it is evidence, and welcome evidence, of the growing appreciation of the Institute's services to Indian industry. The criticism sometimes levelled that Forest research in India is divorced from the practical problems of industry would thus appear to be no longer well founded.

It is difficult to pick out individual items from this interesting although crowded report. Any selection which appear specially significant to the reviewer tends to be arbitrary. Mr. A. L. Griffith's contributions to the technique of raising teak plantations is recorded in the Sylvicultural Section. The reference to the laying of ecological quadrats in the "Controversial areas, Bamiaburu, Bihar" (p. 27) is presumably to the contour-trenching-climatic factors controversy. Under Entomology, mention is made of the "suspicious symptoms" produced by four species of insects in the sandal spike experiments but "these symptoms have not yet been transmitted by grafting". Further, the opinion is expressed that "the vector of spike disease is likely to be a species of Jassidæ associated with agricultural crops or weeds and thence intrusive in sandal forests." Under "Timber Testing", the facilities of the Institute are increasingly made use of by the aviation authorities and a report on air-craft timbers has been submitted to the Air Ministry in England. The work on "Ascu" is in progress in the "Wood Preservation Section". Special mention must be made of the experiments on wrapping papers from Ulla (*Anthristiria gigantca*) grass and it is pleasing to note that some members of the Paper Makers' Association have contributed money towards the research expenses of the "Paper Pulp Section". The Chemistry Branch gives an account of progress achieved under Drugs, Oils, Fats and Essential Oils. Work has just been begun on Forest Soils. One is rather surprised and disappointed to read that research under "Minor Forest Products" had to be greatly curtailed during the year during report *for want of funds.*

The publication is well got up and printed on paper made at the Institute from *Saccharum arundinaceum.*

A Review on the Indian Cotton Textile Industry. By H. P. Gandhi. (Gandhi & Co., Calcutta), 1940. Pp. 150. Price Rs. 3.

Mr. M. P. Gandhi has once again rendered service to the Indian Cotton Textile Industry by publishing his 1940 annual. He has arranged the information available on the Cotton Textile Industry in a comprehensive volume, which should serve as a very useful guide for those engaged in the Cotton Industry. He has followed more or less the same lines as in the past in arranging the data under various captions. As he has pointed out he was experiencing considerable difficulty in collecting statistical information on imports and exports, as official information was withheld owing to war conditions. The statistical tables are, therefore, incomplete. All the same, a review of the various tables forcibly brings home the importance of the Indian Cotton Textile industry in the national economy of India. There has been a steady increase in the number of mills, the number of active spindles, the number of active looms, number of workmen engaged in the industry and in the consumption of cotton in the past year compared with that of previous years. Table No. 15 sums up the economic position

of the industry. The figures indicated under several heads except those shown under hand-loom production are from authentic sources. They reveal that there has been a slight set-back in the past year compared with the steady progress the industry was maintaining in the past decade from year to year. Compared with 1929–30, the imports in piecegoods have fallen from 1900 million yards to 560 million yards in 1939–40, whereas the production of piecegoods in Indian mills and on hand-looms has increased from 2,290 million and 1,380 million to 3,790 million and 1,600 million yards respectively, the *per capita* consumption in the same interval varying from 15·97 to 16·5 yards during the same interval.

Mr. Gandhi has followed the same lines as in previous years in arranging the matter pertaining to the various phases of the development of the Indian Cotton Industry from its early days. He has forcibly brought out before the public, the view held by the industry that the New Indo-British Trade Agreement of 1939 is not in the best national interest and has for this purpose traced the history of the negotiations in the matter quite comprehensively.

Mr. Gandhi has also devoted much attention in presenting the difficulties that the industry was experiencing in matters connected with labour engaged in the industry in the different parts of the country and has made an impartial survey of the situation in the various provinces.

Under the caption "The Hand-loom Industry in India" Mr. Gandhi has merely mentioned the work of the Eleventh Industries Conference. In view of the importance of the hand-loom weaving industry which according to Mr. Gandhi accounts for nearly 27 per cent. of the total production of cotton goods produced in India, it is desirable to have a more comprehensive review of the industry in all its phases. Even if a detailed review of work done in each province and State, even of those to which grants are given from Government of India, can be included in future issues of Mr. Gandhi's annuals, a very useful service will be done to the industry as detailed information on each and every important phase of the cotton industry would become available.

Mr. Gandhi's review of the general conditions of the industry during 1939–40 is both instructive and convincing. After reading through the annual, one cannot resist the conclusion that the cotton textile industry of India is our largest industry, controlled, manned and financed by the nationals of the country. It is one of the few organised industries in India which the Indian industrialists have been able to develop against heavy odds, and indeed against severe competition from the industrially advanced countries. It occupies a very important position in the National Economy of India and with it the welfare of millions in this country is closely linked up.

B. K. MURTHY.

HYDROCARBON CHEMISTRY

THIS is a somewhat prosaic title to the interesting group of papers presented and discussed at the 70th General Discussion held by the Faraday Society (Gurney and Jackson, 1939, price 12*sh.* 6*d.*). To the present-day student of text-book organic chemistry and the high brow organic chemist pursuing the synthesis of vitamines, harmones, colouring matters and new medicinal chemicals, the chemistry and properties of hydrocarbons are perhaps the least inspiring. And yet the chemistry and technology of hydrocarbons presents one of the thrilling chapters in modern chemistry and none who has gone through the present monograph can lay it down without being deeply impressed by the immense importance and vast potentialities of the new synthetical methods applied to petroleum and coal. There are essentially two aspects of the subject. The first is concerned with the increasing demands for high grade aviation and automobile fuels with rising octane and cetane numbers. It is found that aromatic hydrocarbons have in general increased anti-knock characteristics and thus one of the problems is that of bulk production of aromatic compounds from the open chain raw materials available, by methods much more economical than those hitherto known for the syntheses of fine chemicals. Secondly, the various hydrocarbons, synthetic or natural, are likely to assume increasing importance as basic materials for a number of newer chemical industries, such as, to give outstanding examples only, the production of synthetic glycerol, and the new polymerisation processes for production of lubricants and plastics.

The technical development of several

phases of hydrocarbon chemistry has already reached a high standard, thanks largely to the enterprise of the petroleum technologists of America. However, our corresponding knowledge of the mechanism and theory of the reactions involved are by no means clear. This lacuna needs to be filled up, as such a basic knowledge will not only be helpful to the improvement of industrial technic, but also provide new ideas for development. The aim and purpose of the Faraday Society Symposium has been to bring together the various schools of thought for a helpful discussion and progress towards the complete elucidation of the mechanisms of the reactions.

The contributions from the notable gathering of scientists have been conveniently grouped into four main sections: I. Homogeneous thermal reactions of hydrocarbons. II. Catalytic reactions of hydrocarbons. III. The mechanism of the technical synthesis and transformation of hydrocarbons. IV. Olefine polymerisation. The significance of the several contributions has been very elegantly and lucidly brought out in an introductory paper by Prof. E. K. Rideal, who was also the President of the Symposium. In general a knowledge of the kinetics of reactions includes the elementary steps and the energies of activations. Of the large number of reacting organic molecules, the hydrocarbons lend themselves easiest to fundamental calculations of these factors and the place of honour has been given to four such contributions of "theoretical chemists". Lennard Jones and Coulson give an excellent review of the theoretical valence rules in molecules, while M. G. Evans has suggested that the low activation energy for the dimerisation and polymerisation reactions is due to the large resonance energy in the complexes formed in the transition state. Other papers in Part I deal with studies of the mechanism of thermal cracking processes, all of which, as was first emphasised by F. O. Rice, are essentially chain-like in character, a free radical like methylene being the initiator. The possible alternative methods of chain propagation and breaking have received detailed attention in these papers and the accompanying discussions.

The methods of catalysis are becoming a normal procedure in hydrocarbon industries. Such processes can be operated at a lower temperature and permit of more selective control in the nature of the products than the purely thermal reactions. Although many of the successful commercial developments have not awaited any complete understanding of the whys and wherefores of catalyst behaviour, such knowledge will doubtless be helpful for further, quicker and surer progress. Part II of the Symposium deals with the catalytic reactions of hydrocarbons. A notable contribution is that of Taylor and Turkevich who have reviewed the present position with reference to catalytic ring closure of open-chain hydrocarbons and also reported how with chromium oxide gel as a typical catalyst and normal heptane as typical paraffin hydrocarbon quantitative conversion to aromatic hydrocarbon can be secured.

In these times of Ersatz and National self-sufficiency, the synthetic production of liquid hydrocarbon fuels is one of no mean importance. In the Fischer-Tropsch process discovered as early as 1926, and since developed on an industrial scale in Germany, paraffin and olefine hydrocarbons ranging from lightest members up to solid waxes are simultaneously produced from CO and H_2, in the presence of promoted iron, cobalt and nickel catalysts, at atmospheric pressures and temperatures about 200° C. Secondly the catalytic high pressure hydrogenation of coal and oil has also been successfully developed for the production of petrol and other refined products such as lubricating oils, etc. The group of papers in Part III are devoted to the elucidation of the mechanism of these reactions. Included in this group are also some studies of the processes for the production of quality fuels of high anti-knock value, by the catalytic aromatisation of the aliphatics and by the addition reactions between saturated hydrocarbons and olefines to produce higher isoparaffins.

Polymerisation is yet another technique for extending the possibilities in the processing of hydrocarbons. A variety of products such as lubricants and plastics can be synthesised in this manner. The chemistry of growth of macromolecules of hydrocarbons is therefore of special interest and forms the main interest of the group of papers in the last section.

It is evident from the above that the contents of this volume must be of absorbing interest as much to the academic as to the technological scientists. A Faraday Society General Discussion needs no additional recommendation.

M. A. GOVINDA RAU.

SCIENTIFIC RESEARCH AND THE FUTURE OF INDIAN INDUSTRY

THIS is the title of an interesting address delivered by Prof. S. S. Bhatnagar as "The Third J. C. Bose Memorial Lecture" at Calcutta on 30th November 1940. It will be a commonplace to enumerate the many examples of what scientific research has done to industry in the world. Still a few topical illustrations may be given in order to convince the hasty capitalist who wishes to apply science to industry immediately, that a certain amount of fundamental research is essential before a discovery or invention can be exploited to its best advantage. The Society of Chemical Industry of England awarded its Perkin Medal for 1937 to Thomas Midgely for his researches which culminated in the discovery of tetraethyl lead and freon. The discovery of tetraethyl lead was the result of a series of fundamental investigations based on the original observation that elemental iodine dissolved in motor fuel in very small quantities greatly enhanced the anti-knock character of the fuel. Similarly in the development of non-toxic non-flammable refrigerents in the form of organic fluorides a logical study according to the properties of the Periodical Table was a main factor.

Not all the honours of discovery useful to industry go to chemistry. Physics shares a good many of them and occasionally with a rapidity and beauty which bewilder the chemist. One example of physics contributing to the creation of a new industry is that of the production of cold, resulting in the liquefaction of the permanent gases. The pioneering researches of Sir J. C. Bose himself on the properties of electric waves would have been commercialised immediately had only India been an industrially developed country.

If Indian researches have not been employed on a large scale, it is not because they are of no importance. This neglect is largely due to the lukewarm interest of our Government in the past in these activities, an utter lack of appreciation on the part of our industrial magnates as to the possibilities of scientific research in relation to industry and the sophisticated and too philosophical a view which the scientists themselves have taken of their discoveries. Still some progress has been made. The inspiring genius of Sir P. C. Ray enabled him to sow the seeds of Indian industry which have now blossomed forth in the shape of the Bengal Chemical and Pharmaceutical Works, Ltd., one of our largest chemical factories in India. Further industrial programmes are afoot under the ægis of the Tatas, the Governments of Mysore, Baroda and Kashmir, and others. These developments which are in the process of materialising in the near future will give a fillip to scientific research which no other movement has yet been able to impart.

As an example of what the more wide-awake nations of the world are doing for their industries, may be taken the progress which Japan has made in this direction after the China incident. The address recently delivered by Dr. K. G. Kita, Chairman of the Society of Chemical Industry of Japan, should be an eye-opener to Britain and to India. In India, several new plants are in the process of being erected and several others have already come into existence. For example, we have now in the country a plant for the manufacture of chlorine and bleaching powder, and a plant for the production of nitric acid from synthetic ammonia. A big plant for the manufacture of benzene and toluene from coal is being put up at Tatanagar, and orders have been placed for a plant for the production of aviation lubricants in N. India. However, the greatest scope for India lies in her ability to make good by indigenous production what now constitutes a shortage in industry owing to restricted imports, and this presents a vast field of investigation for the technical man and the universities. The Board of Scientific and Industrial Research and workers in the field of Industrial Research are alive to this and many investigations have been undertaken with a view to introducing the manufacture of auxiliaries in industries which have become already firmly established, as the most immediate service which research can render is to make the existing organisations equal to an emergency. Such research schemes on Scientific Instruments, Graphite, Fertilisers, Glass and Refractories, Vegetable Dyes, Cellulose, Metallurgy, etc., are being carried out under fifteen different committees. The Indian investor should also investigate the possibilities of developing uses for the raw materials whose exports were so large from the country that their disposal now constitutes

a serious problem. In this category may be mentioned the vegetable oil-seeds, bones, and skins, and leather wastes.

Scientific research in India has already achieved notable success. These cover the fields of neutral glass industry, production of large quantities of pectin at extraordinarily low prices, luminous paints of non-radio-active origin, wood treating process utilising the impregnation of naturally occurring resins, preparations of chlorinated rubber, manufacture of paints and varnishes from Bhilwan nuts, etc.

One should not forget, however, that scientific and industrial research in this country has its handicaps. We are over-burdened with all sorts of tariffs and duties. Our trade and our laws are occasionally not quite helpful nor can it be said that political considerations do not come in the way of some of the investigators.

CENTENARIES

Horrocks, Jeremiah (1617–1641)

JEREMIAH HORROCKS, 'the pride and boast of British astronomy' in the words of Sir John Herschel, was born of a poor schoolmaster at Toxteth near Liverpool in 1617. He matriculated in his thirteenth year and entered the Emmanuel College, Cambridge, as a sizar. He had to leave the university before qualifying himself for a degree. Yet he determined "that the tediousness of study should be overcome by industry, my poverty by patience and that instead of a master I would use astronomical books". Having found Lansberg's *Tables* untrustworthy, he studied the works of Kepler, and Tycho Brahe, and Galileo's *Astronomical dialogues*. Finding that Kepler's numbers were incorrect, he set them right from his observations. In May 1638, he bought a telescope for half-a-crown and used it to observe the solar eclipse of 22 May 1639.

Venus in Sole visa is the title of the book in which Horrocks described his observation of the transit of Venus, thereby earning unquestioned priority for his motherland. It was published posthumously in 1672. In the course of his studies, he became convinced that a transit of Venus across the Sun, overlooked by Kepler, would actually occur in the afternoon of 24 November 1639. He announced the approaching phenomenon to his friend Crabtree and prepared to observe it by throwing upon a screen in a darkened room the image of the Sun formed by his little telescope. At 3-15 p.m. he saw with rapture the disc of Venus already entered upon the Sun. He and Crabtree were the sole observers of this unprecedented spectacle. Among the results secured by Horrock's rough measurements were corrections to the orbital elements and apparent diameter of Venus, but he hardly guessed how fundamental his observations would prove to be in the determination of the parallax of the Sun and planets.

Horrocks was also the first to conjecture that the lunar orbit should be an ellipse with the earth in one of the foci and with a varying eccentricity and an oscillating major axis. Newton afterwards showed that both the conjectures were right and were really corollaries of his theory of gravitation.

The works of Horrocks were caused to be published by the Royal Society under the editorship of Dr. Wallis. They came out in 1879 with title *Angli opera postuma*.

Horrocks died prematurely 3 January 1641.

Godfrey, Ambrose (*d.* 1741)

AMBROSE GODFREY was employed in the laboratory of Robert Boyle. He later established an independent laboratory in Southampton Street, Covent Garden. He was deputed to analyse the water of the medicinal spring at Nottington. He was elected F.R.S. in 1730. He contributed two papers to the *Phil. Trans.*, one entitled *An account of some experiments upon the phosphorus uninæ* and the other *An examination of Westashton well-waters*.

Godfrey invented and took a patent for a fire extinguisher. Godfrey's method of "suffocation and explosion" was tried 19 May 1761 in a house erected for the purpose by the Royal Society of Arts in Marlybone Fields. It is said to have proved an entire success.

Godfrey died 15 January 1741.

Huddart, Joseph (1741–1816)

JOSEPH HUDDART, a British hydrographer, was born 11 January 1741, at Allenby in Cumberland. He was educated at his parish school. Even as a boy he showed aptitude for mathematics and mechanics and constructed the model of a mill.

In 1778 Huddart entered the service of the East India Company through the good offices of his cousins who were both shipowners and holders of East India stock. As commander of the Ship "Royal Admiral" he made four voyages to the East. Meanwhile he interested himself in the survey of the coasts and ports that came under his notice, and constructed charts of Sumetra and the Indian coast from Bombay to Cocanada.

Huddart retired from the service of the East India Company in 1788. In 1791 he was elected F.R.S. Several years before, the accident of a cable parting had turned his attention to the problem of making ropes with an equal distribution of strain on the yarns. He now entered into business for the manufacture of cordage on this principle and made a handsome fortune.

Huddart died at London 19 August 1816.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

New Year Honours.—The New Year Honours list contains the names of the following men of science:—

Knighthood: Dr. S. S. Bhatnagar, Director of Scientific and Industrial Research, Calcutta; Brevet-Colonel Ram Nath Chopra, I.M.S., Director, School of Tropical Medicine, Calcutta. *C.I.E.*: Mr. A. M. Livingstone, Agricultural Marketing Adviser to the Government of India; Mr. Lionel Fielden, lately Controller of Broadcasting, Government of India; Mr. H. G. Champion, I.F.S., lately Conservator of Forests, U.P. *C.B.E.*: Lt.-Col. C. A. Maclean, I.A.S., Cane Commissioner, Bihar, and Officer Commanding the Bihar Light Horse A.F. (I). *O.B.E.*: Mr. J. R. Haddow, Indian Veterinary Service, Veterinary Research Officer, Izatnagar; Prof. S. R. Moolgavkar, Professor of Surgery, Grant Medical College, J. J. Hospital, Bombay.

The Hydrogen Bond.—The September number of the *Transactions of the Faraday Society* (Vol. XXXVI, No. 233, 1940) reports a general discussion of the Society on the "Hydrogen Bond" held on 17th May 1940 under the presidentship of Prof. E. K. Rideal, M.B.E., D.SC., F.R.S., Six papers were submitted for the session and a large number of scientists took part in the subsequent discussion. Reporting on the Hydrogen Bond in Protein structure, Astbury pointed out that proteins depend for the proper exercise of their functions, or even for their very existence, on the presence of water, of which they take up large quantities. The water that proteins take up fall roughly into two classes—the loosely bound and the tightly bound; and it is the tightly bound water that is linked by co-ordinate or hydrogen bonds with the oxygen or nitrogen atoms in the carbonyl, hydroxyl, imino and amino groups of the structure. The loosely bound or "free" water is taken up by the intermicellar spaces. The "salt-like linkages" and the "back-bone linkages" are discussed; the intermolecular hydrogen bridges are observed to show a close similarity to the back-bone linkage of the extended fibrous proteins. The whole concept of polymerisation through oxygen-hydrogen-nitrogen bridges is concluded as being a generalisation of the familiar back-bone linkage. Bawn, Hirst and Young, in presenting their paper on the Nature of the Bonds in Starch, discussed the characteristics of the binding between the repeating units which go to make up the macromolecule of starch. Experimental evidence in regard to the properties of the starch molecule is shown to be inconsistent with those of a structure held together by hydrogen bonds. A consideration of the kinetics of the disaggregation of starch is shown to favour the hypothesis that the repeating units of starch are bound together by normal covalent bonds as found in, for instance, the disaccharides. Sutherland summarised the main results of infra-red investigations in the study of the hydrogen bonds both intermolecular and intramolecular. Following up the same subject, Fox and Martin discussed (1) the intermolecular bonding between alcohol (and phenol) molecules forming somewhat indefinite complexes; (2) the bonds between carboxylic acid molecules leading to dimers; and lastly (3) the intramolecular association or chelation in single molecules. They pointed out that the expression "energy of the hydrogen bond" has been used in the literature with different meanings by several authors and attempted to clear up this position. Robertson presented available X-ray evidence in the formation of intermolecular hydrogen bonds in organic crystals such as α- and β-resorcinol, oxalic acid dihydrate, glycine, etc. Lastly Angus and Hill reported their investigations on the diamagnetic susceptibilities of substances capable of forming hydrogen bonds conducted in order to ascertain (*a*) if the formation of such bonds could be detected by magnetic measurements, and (*b*) whether any correlation is possible between the strength and nature of the bond and the magnetic data. These preliminary experiments seem to reveal that when formation of a hydrogen bond simultaneously involves ring formation, the susceptibility of the hydrogen-bonded structure is considerably less than the anticipated additive value and diminishes as the concentration of solute increases. On the other hand, when an "open" addition compound is formed by intermolecular hydrogen bonding between solute and solvent the susceptibility of the solute increases with solute concentration. In the discussion that followed Mrs. Lonsdale pointed out that any satisfactory study of the effect of hydrogen bonds on diamagnetism must take into account the three principal susceptibilities of molecules known to contain such bonds; at the Davy Faraday Laboratory she announced that work on these lines was already begun. The results of this investigation, which will be eagerly awaited, will be a most valuable contribution to our knowledge.

L. SIBAIYA.

Salt Accumulation in Soils and their Reclamation.—The deterioration of soils newly brought under irrigation due to the rise of salts to the surface of the soil by irrigation and the formation of alkaline soils due to the seasonal movements of soil moisture during rainfall and irrigation have formed the subject of research in the Irrigation Research Institute, Punjab, and as the result precise numerical expression has been made possible to the degree of such deterioration especially in relation to the scope for profitable reclamation of these soils (E. Mackenzie-Taylor, *Indian Farming*, 1, No. 9). The conclusions are stated as follows:—If the salt content of the soil exceeds 0·5 per cent. and the alkalinity a pH value of 9·0 then successful crops of wheat and cotton cannot be grown and only a moderate crop of rice can be grown. Secondly, if the salt content exceeds 0·5 per cent. and the alkalinity is between 9·0 and 9·2 then simple leaching will render the soil fit for

Add the following paragraph to the note entitled "Manurial Experiments on Bananas" on page 43:—

Nitrogen gave promising results and though these plots were not laid down suitably for statistical analysis still the indications were strong to show that nitrate of soda even in the small doses applied in the third and fourth years produced much higher yields. The increases over the control were 29, 40 and 11 per cent. in the first, second and fourth years respectively while in the third year there was a decrease of 4 per cent. The nitrate plots developed much leaf-spot disease and the increased yields were in spite of such disease incidence.

A. K. Y.

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rice. Thirdly, if the salt content exceeds 0·5 per cent. and the pH value lies between 9·2 and 9·5 then the land can be economically reclaimed but the first crop of rice will be low in yield. Fourthly, if the salt content exceeds 0·5 per cent. and the pH value exceeds 9·5 then economical reclamation is impossible. For the growing of cotton in this tract it is stated that within a zone six feet in depth from the surface no portion should contain more salt than 0·2 per cent. nor the pH value exceed 8·5 for maximum yields. A. K. Y.

Manurial Experiments on Bananas.—Manurial experiments on bananas principally with a view to finding out if and to what extent potash fertilisers are advantageous which have run for a period of four years are reported by the N.S.W. Department of Agriculture, Australia (*Agricultural Gazette*, 51, Part 10). The experiments consisted of a trial of sulphate of potash at the rates of 21 lb., 41 lb. and 61 lb. per stool per year compared with no sulphate of potash. The treatments were randomised in the blocks and the blocks were repeated four times. All plots received a basal dressing of 1½ lb. of bone dust per stool per year. To test the effect of nitrogen two blocks received nitrate of soda as follows:—3 lb. per stool in the first year, 1½ lb. in the second year and ¾ lb. in the third and fourth years per stool.

The yield figures were studied statistically and it was found that the potash treatments produced no significant increases in the yield of marketable fruit in any year. There was, however, some evidence that potash increased the size of the fruit but the differences were not statistically significant.

New Uses for Indian Vegetable Oils.—Almost all the common Indian vegetable oils can be used satisfactorily as diesel engine fuel in place of mineral diesel oil, according to the Industrial Research Bureau's bulletin entitled "Indian Vegetable Oils as Fuels for Diesel Engines" which records the results of three years' investigations into the subject made at the Government Test House, Alipore, Calcutta. For this substitution, hardly any alterations are necessary to the ordinary diesel engines, and groundnut oil, cotton seed oil and rape seed oil gave the same smooth and trouble-free operation as the mineral oil. The behaviour of a number of other oils, including castor, coconut, til, mohua, kapok, karanji, punnal or undi and polang, has also been investigated. Although generally more expensive than the cheaper mineral oil, under certain circumstances they could find immediate application as engine fuels. For instance, in certain parts of the country where mineral oil is more expensive and vegetable oils are locally produced and comparatively cheaper, the latter may prove economical and useful. With the present slump in the oil export market, the prices of some of the vegetable oils have fallen. The present investigations indicate one way in which the oils can be utilized in this country, which is one of the largest producers of vegetable oils in the world. It was found that the power reduction of the engine when using these vegetable oils was practically negligible and amounted to not more than about 2 to 3 per cent. This is significant in view of the much lower calorific value of the vegetable oils, as it indicates that the heat efficiency of vegetable oils is definitely higher than that of mineral oils when used in this way.

Limestone and Marble in N. W. F. P.—The North-West Frontier Province has an almost inexhaustible source of limestone and rich deposits of good quality white statuary marble and handsome banded marbles, according to Dr. A. L. Coulson of the Geological Survey of India, whose Professional Paper on the mineral resources of the Frontier Province and the directions in which they can be developed has just been published. Dr. Coulson is of opinion that the white marble found in the Province should be carefully conserved for ornamental statuary work and the more abundant coloured varieties should be used for ordinary building purposes. The mineral production of the Frontier Province is extremely small and consists almost entirely of salt, limestone, marble and road material. There is, however, abundant power available from the Malakand Hydro-Electric Scheme and Dr. Coulson recommends that every encouragement should be given to industrial enterprises wishing to take advantage of this power. The only known deposits of coal in the Frontier Province are in the Surghar range on the border of Kohat and Mianwali (Punjab) districts. Dr. Coulson thinks that encouragement should be given for the development of the deposits as soon as the results of the survey of the area are known. Abundant deposits of gypsum are found untouched in the Kohat and Dera Ismail Khan districts. Attention can profitably be directed, says Dr. Coulson, to the utilisation of this potential economic mineral.

Shellac Floor Varnishes in America.—It is estimated that some 12,000,000 lb. of shellac, mostly prepared from seedlac imported from British India, is consumed every year in the United States of America for the preparation of floor varnishes, according to a bulletin issued by the London Shellac Research Bureau. A dozen factories are busy all the year round bleaching the seedlac to get rid of the natural orange red colour of the material. In America, where wooden floors are in almost universal use, the best methods of polishing such surfaces with the minimum of work involved in daily cleaning and maintenance generally attracted considerable attention. The method which is now widely used is the application of spirit shellac solutions. These have resisted the competition of substitutes because of the cheapness of materials from which they are made (shellac and industrial alcohol), ease of application, durability, simplicity of renewal and care-free maintenance.

War and Indian Coal.—In view of the altered position in the Mediterranean many countries in the Middle East and Near East have now

turned to India for their supplies of coal. In recent months firm demands were received from the Sudan Railways for 16,000 tons and from Palestine (Haifa) for 20,000 tons. Further demands for 25,000 tons a month were received from Greece. Hong Kong asked for 5,000 tons and orders for 30,000 tons for Port Said, Malta, Aden and Egypt were placed with Indian firms direct by the British Shipping Controller, London. Demands were also received for hard coke and gas coke from Middle East and Palestine respectively.

South Indian Epigraphy.—The collection of 471 stone inscriptions, 13 copper-plate grants belonging to the several ancient South Indian dynasties and many objects of archæological interest is mentioned in the Annual Report on South Indian Epigraphy for 1936–37 just published. For this purpose 283 villages in the Madras Presidency and 153 in the Bombay-Karnatak were visited. Besides, 91 photographs of objects of archæological interest including certain rock-cut sculptures at Pillaiyarpatti and Kunnakkudi in the Ramnad District were obtained. A few sites containing pre-historic and proto-historic remains in the Tinnevelly and Chittoor Districts were examined and burial urns and pottery were recovered.

In the South Arcot District some caverns with rock-cut beds known locally as the *Panchavarparai* were discovered. These are similar to those found in the Pandya country and attributed to the third century B.C. Of the inscriptions collected in the Madras Presidency, the earliest are four Brahmi records going back to about third century A.D., recovered from certain ancient Buddhist sites in the Guntur District. Two of these belong to the Ikshvaku Kings, Vira Prisadata and Ehuvula Chantamula, who ruled in the Krishna valley and who are responsible for the splendid Buddhist monuments of Nagarjunikonda. Two inscriptions recovered from Srirangam near Trichinopoly are of some general interest. One records the establishment by a Hoysala general of the thirteenth century A.D. of a dispensary as an annexe to the Ranganatha temple. The other mentions the consecration in the place of an image of Dhanvantari, the Aseulapius of the Hindus.

Getting the Most from Teak Plantations.—Information of use alike to the trade and to those interested in forestry is given in a compilation on yield of teak plantations, just brought out by the Forest Research Institute, Dehra Dun, in its *Indian Forest Records*. The present publication is the first attempt at a comprehensive yield table for teak plantations throughout India and Burma.

Teak is one of the most widely distributed and economically one of the most important timber species in India. Because of the high prices that teak timber fetches as compared with the timber of its other associates in the mixed deciduous forests of India and Burma, it has been planted more extensively than any other single species. The existing teak plantations are now estimated to cover an area of roughly 300 square miles, and about 10 square miles are being added annually in India and Burma.

Schemes for Civil Industries in India.—The Government of India sanctioned more than Rs. 2,00,000 for various research schemes recommended by the Government virtually *in toto*. This grant was made for equipment for laboratories or small plants, and to cover remuneration for research workers. It was proposed to appoint for the time being two or three more research workers at the Alipore Laboratory which was to be expanded and provided with more equipment as occasion arose.

As a result of the efforts of the **Indian Chemical Manufacturers' Association, Calcutta,** the Government of India have decided to exempt *Benzol* used in the manufacture of medicinal preparations from excise duty. The Government of India levied an excise duty of annas 10 per gallon (subsequently increased to annas 12) on Benzol on the ground that it can be used as motor spirit as a substitute for petrol. The Association had pointed out to the Government that Benzol was used as a solvent in the manufacture of Alkaloid preparations but on account of the excise duty the Alkaloids prepared in India could not stand in competition with the imported Alkaloids in normal times. The step now taken by the Government of India would enable utilisation of large quantities of Benzol manufactured in coke oven plants which was till now going to waste. It would also give impetus to the manufacture of Alkaloid preparations in this country.

Indians in Malaya.—The Agent of the Government of India in Malaya in his Report for the year 1939 just published observes that rubber and tin—the two key industries of Malaya—mainly depend on immigrant labour. While the Chinese predominate in mines and factories, South Indians are employed in large numbers on rubber estates and public and Government departments mostly as unskilled labourers. At the end of 1939, the total Indian population in Malaya was nearly 745,000, forming 13·8 per cent. of the total population. About 80 per cent. of them are wage-earners engaged in some form or other of manual labour.

Despite the ban on assisted emigration to Malaya and the increase in rubber production quota which averaged 62·5 per cent. for 1939 as against 55 per cent. for 1938, there was ample supply of Indian and Chinese labour available locally to produce the full permissible quota of 75 per cent. during the last quarter of 1939. The average price of rubber, which went up to 11 to 12*d*. per lb. after the outbreak of war, was 9*d*. per lb. for 1939 as against $7\frac{7}{32}$ *d*. for 1938.

Wage rates for Indian labourers on estates which remained at the reduced level of 45 cents a day for men and 35 cents a day for women during the first three quarters of 1939, rose to 50 and 40 cents respectively with effect from October 1, 1939. Daily and monthly paid labourers and workers employed under the public authorities were granted by S.S. and

F.M.S. Governments a cost of living allowance ranging from \$1 to \$2 per month.

University of Mysore.—A meeting of the Academic Council was held on the 21st December 1940. Among the propositions that were passed, mention may be made of the following:—(1) Extension of the duration of the L.M.P. Diploma Course from 4 to 5 years. (2) Revision of the Course of Study for the B.A. Honours Preliminary Examination for the Social Philosophy Branch. (3) Revision of the detailed course of study in Psychology for the B.A. Honours Degree Examination. (4) Scheme of Examination in Urdu for the B.A. Honours Degree Examination. (5) Addition of Urdu to the list of subjects that may be offered for the Degree of Master of Arts. (6) Ordinance respecting the institution of the Master's Degree in Engineering. (7) Ordinances relating to the institution of the Doctorate, *viz.*, D.Litt., D.Sc., D.E., and D.Sc. (Anatomy, Physiology).

The All-India Economic Association and the All-India Political Science Association which were invited by this University to hold their Conferences at Mysore this year, met during the month. The Joint Conference of the two Associations was opened on the 28th December 1940, by His Highness the Maharaja of Mysore.

University of Calcutta.—Mr. Phanindrachandra Dutta is admitted to the D.Sc. degree, in consideration of his thesis on "Studies in the Sesquiterpene Series and Studies in the Cyclopentane Series".

Messrs. Phanindranath Brahmachari, Sunilkrishna Datta and Krishnadhan Chatterjee have been admitted to the M.D. degree on the basis of an examination.

Srimati Bibha Majumdar, the holder of Premchand Roycand Studentship in Science, will be awarded a Mouat Medal at the forthcoming Convocation of the University.

Indian Science Congress.—At the annual meeting of the General Committee of the Indian Science Congress Association held in Benares on January 6, Mr. D. N. Wadia, Mineralogist, Ceylon Government, was elected President for the 29th Session of the Indian Science Congress, which will be held at Dacca under the auspices of the University of Dacca from the 2nd to the 8th January 1942.

The following were elected Presidents for the different sections:—

Mathematics and Statistics: Prof. P. C. Mahalanobis, Professor of Physics, Presidency College, Calcutta.

Physics: Prof. B. B. Ray, Khaira Professor of Physics, Calcutta University.

Chemistry: Dr. M. Qureshi, Head of the Department of Chemistry, Osmania University, Hyderabad, Deccan.

Geology: Dr. Raj Nath, Head of the Department of Geology, Benares Hindu University, Benares.

Geography and Geodesy: Mr. George Kuriyan, Head of the Department of Geography, Madras University, Madras.

Botany: Dr. N. L. Bor, Forest Botanist, Forest Research Institute, Dehra Dun.

Zoology: Dr. H. S. Rao, Assistant Superintendent, Zoological Survey of India, Indian Museum, Calcutta.

Entomology: Dr. D. Mukerji, Zoological Laboratory, University of Calcutta, Calcutta.

Anthropology: Dr. M. H. Krishna, Professor of History and Director of Archæological Research, Maharaja's College, Mysore.

Medical and Veterinary Research: Dr. C. G. Pandit, King Institute, Guindy, Madras.

Agriculture: Dr. Nazir Ahmed, Director, Cotton Technological Laboratory, Matunga, Bombay.

Physiology: Prof. B. T. Krishnan, Professor and Head of the Department of Physiology, Medical College, Calcutta.

Psychology and Educational Science: Dr. G. Pal, Department of Psychology, Calcutta University, Calcutta.

Engineering: Mr. H. P. Philpot, Principal, Engineering College, Benares Hindu University, Benares.

At the Annual Meeting of the **Indian Academy of Sciences**, held at Waltair, in December 1940, the following were elected Office-bearers and members of the Council for the period 1940–43:—

President: Rajasabhabhushana Sir C. V. Raman. *Vice-Presidents*: (1) Lt.-Col. S. L. Bhatia, (2) Prof. K. S. Krishnan, (3) Rajasevasakta Dr. B. K. Narayan Rao and (4) Prof. Birbal Sahni. *Secretary for Section A*: Prof. B. S. Madhava Rao. *Secretary for Section B*: Prof. A. Subba Rau. *Treasurer*: Prof. B. Sanjiva Rao. *Members of Council*: (1) Dr. Nazir Ahmed, (2) Dr. S. K. Banerji, (3) Prof. S. Bhagavantam, (4) Prof. Y. Bharadwaja, (5) Prof. D. R. Bhattacharya, (6) Prof. R. Gopala Aiyar, (7) Dr. E. McKenzie Taylor, (8) Prof. S. Ramachandra Rao, (9) Dr. K. R. Ramanathan, (10) Mr. B. Rama Rao, (11) Prof. L. Rama Rao, (12) Prof. M. A. Sampathkumaran, (13) Prof. B. K. Singh, (14) Shastravaidyapravina Dr. S. Subba Rao and (11) Prof. A. V. Telang.

Sir C. V. Raman has been elected an Honorary Fellow of the Optical Society of America in recognition of his eminent services to the Science of Optics.

Indian Institute of Science, Bangalore.—The Government of His Exalted Highness the Nizam of Hyderabad have enhanced the annual grant to the Indian Institute of Science, from Rs. 2,000 to Rs. 10,000.

SEISMOLOGICAL NOTES

December 1940.—During the month one moderate and seven slight earthquake shocks were recorded by the Colaba seismographs as against two great and four slight ones recorded during the same month in 1939. Details for December 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
1940		H.	M.	(Miles)		(Miles)	
December 4	Slight	18	39	4490			
9	Slight	11	40	3380			
16	Slight	15	13	2350			
17	Slight	20	12	4600			
18	Slight	11	02	4270			
19	Slight	21	19	3020			
26	Slight	04	37	1220			
28	Moderate	22	08	4750	Near 18° N., 146° E., in the vicinity of Marianne Islands in the Pacific.		

MAGNETIC NOTES

December 1940.—Magnetic conditions during the month were slightly less disturbed than those during the preceding month. There were 6 *quiet* days, 22 days of *slight* disturbance, and 3 of *moderate* disturbance as against 10 quiet days, 18 days of slight disturbance and 3 of moderate disturbance during December 1939.

The most disturbed day during the month was the 30th when a magnetic storm of moderate intensity was recorded. The day of least disturbance was the 6th. Characters of individual days are shown in the following table:—

Quiet days	Disturbed days	
	Slight	Moderate
6–8, 18, 19, 24	1–5, 9–17, 21–23, 25–29	20, 30, 31

There was one moderate magnetic storm during the month of December 1940 as against a moderate storm recorded during December 1939. The mean character figure for the month of December 1940 is 0·90, while that for the same period of 1939 was 0·77.

M. R. RANGASWAMI.

ASTRONOMICAL NOTES

Planets during February 1941.—Mercury will be visible as an evening star in the beginning of the month; it reaches greatest elongation (18° 10′ E.) on February 11 and will be stationary on February 17. After inferior conjunction with the Sun on February 21, the planet passes into the morning sky. Venus continues to get closer to the Sun and is visible as a morning star for a short while before sunrise. Mars which is still faint, is moving eastward in the southern part of Ophiuchus and will be in the constellation Sagittarius at the end of the month.

Jupiter and Saturn have both resumed their eastward motion among the stars, and continue to be conspicuous objects in the western sky in the early part of the night. The former which is moving faster, will overtake the other on February 21, when there will occur a close conjunction of the two planets, the apparent distance at the time being about a degree and a third. There will also be a close approach of the Moon to Saturn on February 3. Uranus will be found in the western border of Taurus about seven degrees to the south-west of the star cluster Pleiades.

T. P. B.

ANNOUNCEMENTS

Lady Tata Memorial Trust.—Applications are invited for Six Scientific Research Scholarships of the value of Rs. 150 per month each for the year 1941–42.

The Scholarships are open to men and women, and will be tenable for a period of twelve months commencing from the 1st July 1941. Any or all the Scholarships may be extended for a further period of twelve months, within the discretion of the Trustees. All old scholars who desire renewal should re-apply.

Applicants, who must be of Indian nationality, must be Graduates in Medicine or Science of a recognised University. They must undertake to work whole time and will be debarred from private practice. In the duration of the period of his scholarship or award the recipient of the benefit shall devote himself to the work before him to the entire satisfaction of the Trustees, who reserve the right to withhold payment on the recommendation of the Advisory Committee.

The subject of scientific investigation which they may select must have a bearing directly

or indirectly on the alleviation of human suffering by disease.

Applications must be forwarded through the Director of a recognised Research Institute or Laboratory where the candidate proposes to work and must be accompanied by a letter from the Director stating that he has critically examined the details of the proposed Research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation and give laboratory facilities.

Applicants must give (*a*) a short resume on the subject indicating present state of knowledge and (*b*) details of the proposed research indicating (*i*) the methods intended to be employed, (*ii*) previous experience in the use of these methods and (*iii*) the experiments to be carried out.

Applications, which must be typed, must give full particulars in the order indicated above and must be addressed to the Secretary, THE LADY TATA MEMORIAL TRUST, BOMBAY HOUSE, BRUCE STREET, FORT, BOMBAY, so as to reach him not later than 15th March 1941.

Forthcoming Publications.—*Temperature, Its Measurement and Control in Science and Industry* (Reinhold Publishing Corporation, New York). This volume consists of about 125 papers presented at a symposium held at New York in November 1939, under the joint auspices of *The American Institute of Physics, The National Bureau of Standards, The National Research Council*, and 12 Scientific and Technical societies. About 1,300 pages and 550 illustrations. Listed price $11.00.

Scripta Mathematica takes pleasure in announcing a facsimile reprint of the 1842–1845 edition of **Peacock's *Treatise on Algebra*** in two volumes. Published at the suggestion and with the collaboration of St. John's College, Annapolis, Md. in two beautifully bound, silver-stamped volumes (Vol. I, xvi + 399 pp.; Vol. 2, x + 455 pp.).

This work, adopted as a text by St. John's College, is invaluable for every teacher of the subject. It is a "must" addition to all libraries not now in possession of the rare, original issue which has been out of print for many years.

Radio in Upper Air Investigation—(a correction).—The author regrets that an error has crept in the arithmetical calculations carried out on page 562, column 1, lines 13 to 26 in a paper of the above title published in *Current Science*, **9**, No. 12, of December 1940. Those lines should be replaced by the following:—

"Therefore, the power radiated will be 0·889 mw. Assuming 40% efficiency for the transmitter, the d.c. input works out to be 2·22 mw. Assuming 10% efficiency, it will be 8·89 mw. Taking the ohmic loss of power in the aerial, the lowering of battery voltage due to drain and lowering of temperature, etc., it is clear that a 45-V plate supply capable of delivering a few milliamperes is quite adequate. Actually satisfactory signals have been received with a 45-V plate supply."

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4570–73.

"Agricultural Gazette of New South Wales," Vol. 51, Pts. 11 and 12.

"The Nagpur Agricultural College Magazine," Vol. 15, No. 2.

"Biochemical Journal," Vol. 34, Nos. 8 and 9.

"Journal of the Institute of Brewing," Vol. 46, Nos. 3, 10 and 11.

"Journal of the Indian Botanical Society," Vol. 19, Nos. 4–6.

"Contributions from Boyce-Thompson Institute," Vol. 11, No. 5.

"Journal of Chemical Physics," Vol. 8, Nos. 10 and 11.

"Journal of the Indian Chemical Society," Vol. 17, No. 9.

"Indian Forest Records," Vol. 4A, No. 1, Silviculture.

"Transactions of the Faraday Society," Vol. 36, No. 234.

"Indian Farming," Vol. 1, No. 12.

"Health Bulletin," No. 11, Malaria Bureau.

"Bulletin of the Indian Central Jute Committee," Vol. 3, No. 9.

"Proceedings of Royal Irish Academy," Vol. 46A, 4–8 and Vol. 46B, 4 and 5.

"Review of Applied Mycology," Vol. 19, No. 10.

"Bulletin of the American Meteorological Society," Vol. 21, Nos. 7 and 8.

"Indian Medical Gazette," Vol. 75, No. 12.

"Journal of the Bombay Natural History Society," Vol. 42, No. 1.

"Journal of Nutrition," Vol. 20, No. 5.

"Journal of the American Museum of Natural History," Vol. 46, No. 4.

"Nature," Vol. 146, Nos. 3698–3702 and 3704–06.

"Journal of the Osmania University," Vol. 7, 1939 and Vol. 8, 1940.

"Indian Journal of Physics," Vol. 14, Pt. 4 (August 1940).

"Proceedings of the Royal Society of Edinburgh," Vol. 60, Pts. 2 and 3.

"Journal of Research," National Bureau of Standards, Vol. 25, No. 2.

"Canadian Journal of Research," Vol. 18, No. 9 (A.B.C.D.).

"Sky," Vol. 5, Nos. 1 and 2.

"Science and Culture," Vol. 6, No. 7.

"Indian Trade Journal," Vol. 139, Nos. 1799–1801 and Vol. 140, Nos. 1802–03.

BOOKS

1. "Catalysis, Inorganic and Organic," by Sophia Berkman, Jacque C. Morell and Gustav Egloff. (Reinhold Pub. Corpn., N.Y.; Chapman & Hall, Ltd., London).
2. "Practical Solution of Torsional Vibration Problems," second edition, Vol. 1, by W. Ker Wilson. (Chapman & Hall, Ltd., London).

CATALOGUES

Cambridge University Press, Autumn 1940, List of Books.

Edward Arnold & Co., Scientific & Technical Books, September 1940.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

(Proceedings)

December 1940. SECTION A.—P. SURYAPRAKASA RAO, P. PRABHAKARA REDDY AND T. R. SESHADRI: *Methylation of hydroxy flavonols using methyl iodide and potassium carbonate.* This reagent resembles diazomethane in the methylation of the naturally occurring flavonols. V. V. KUMARA SASTRY AND T. R. SESHADRI: *Chemical Investigation of Indian Lichens—Part II. Synthetic uses of some lichen acids.* R. D. DESAI AND W. S. WARAVDEKAR: *Studies in naphthalene series—Part V. The properties of 2-stearyl-, 2-palmityl-, and 2-lauryl-1-naphthols and synthesis of 2-octadecyl-, 2-hexadecyl-, and 2-dodecyl-1-naphthols.* R. K. ASUNDI, S. MUJTABA KARIM AND R. SAMUEL: *On the continuous emission spectra associated with electric discharges through flowing vapours of* $SnCl_2$, $SnCl_4$ *and* $SiCl_4$. P. BHASKARA RAMA MURTI AND T. R. SESHADRI: *Paper pulp from annual crops—Part I. Rice straw.* In a straw having cellulose (Cross and Bevan) 37·5% the yield of paper pulp is about 44%. R. S. VARMA: *An infinite series involving the product of Bessel functions and generalised Laguerre polynomials.*

SECTION B.—RUSTOM JAL VAKIL: *An analysis of one hundred normal electrocardiograms (Boys aged 5 to 15 years).* C. P. ANANTAKRISHNAN and P. R. VENKATARAMAN: *The chemistry of garlic* (Allium sativum *L.*)—*Part I. The nitrogen complex.* C. P. ANANTAKRISHNAN AND P. R. VENKATARAMAN: *The chemistry of garlic* (Allium sativum *L.*)—*Part II. Phosphorus distribution.* S. V. GANAPATI: *On the occurrence of* Microspira aestuarii *in the Buckingham Canal at Madras.*

Indian Chemical Society (Journal)

September 1940.—S. S. BHATNAGAR, P. L. KAPUR AND B. D. KHOSLA: *Mechanism of the polymerisation of thiocyanogen from magnetic standpoint.* SANTI RANJAN PALIT: *Physical chemistry of resin solutions. Part II—Nature of resin solutions in organic solvents.* W. V. BHAGVAT, S. HARMALKAR AND S. S. DESHPANDE: *Mechanism of mutarotation of d-oxymethylene-camphor.* V. C. THAKAR, M. R. KAPADIA AND MATA PRASAD: *Determination of the space group of the crystals of o-, m-, and p-nitrobenzoic acids.* S. RAJAGOPALAN: *Synthetical experiments in the sympathomimetics. Part I—The naphthalene series.* D. K. BANERJEE: *Synthesis of 3-(p-hydroxyphenyl)-cyclohexanone.* K. S. MURTY: *The amylase activity of sweet cassava* (Mrnihot palmata). V. S. PURI AND G. C. JUNEJA: *The effect of inorganic colloids on the electrodeposition of nickel and copper.* H. N. RAY: *A new process for quantitative estimation of antimony and its separation from Tin and Lead by means of alkali sulphocyanides.*

Indian Botanical Society (Journal)

December 1940.—D. P. MULLAN: *The root-structure of* Chlorophytum tuberosum *Baker.* M. O. P. IYENGAR AND K. R. RAMANATHAN: Cladospongia, *a new member of the craspedomonadaceæ from Madras.* M. S. RANDHAWA: Zygogonium kumaoensis, *a new species of* Zygogonium *from Kumaon.* C. V. KRISHNA IYENGAR: *Structure and development of seed in* Sopubia trifida *Ham.* B. N. SINGH AND S. N. MEHRA: *The significance of anatomical changes accompanying regeneration of x-rayed* Bryophyllum *leaves.* Y. SUNDAR RAO: *Structure and development of the embryosac of* Drimiopsis kirki *Baker and* Allium govanianum Wall. T. S. RAGHAVAN AND V. K. SRINIVASAN: *A contribution to the life-history of* Bergia capensis *Linn.* T. S. RAGHAVAN AND K. R. VENKATASUBBAN: *Studies in the Bignoniaceæ. I.—Chromosome number and epidermal hydathodes in* Spathodea campanulata *Beauv.* R. E. COOPER AND D. V. SOHONEE: *The growth of the rice seedlings* (Oryza sativa *L. Columbia variety, No.* 42) *in salt solutions of different H-ion concentrations.*

December 1940.—I. BANERJI: *A contribution to the life-history of* Costus-speciosus *Smith.* V. K. SRINIVASAN: *Morphological and cytological studies in the scrophulariaceæ. II.—Floral morphology and embryology of* Angelonia grandiflora *C. Morr. and related genera.* P. PARIJA AND P. MALLIK: *Nature of the reserve food in seeds and their resistance to high temperature.* T. EKAMBARAM AND V. K. KAMALAM: *Permeability of the wall of the xylem vessel.*

Tin and Its Uses

Tin and Its Uses.—The seventh issue of this quarterly review of the International Tin Research and Development Council contains an article describing the properties of cold-reduced tinplate, and showing the advantages of the modern product over the old-style pack-rolled tinplate. Further information is given on the applications of electro-deposited tin coatings, which can be of any thickness desired. It is pointed out that articles of intricate shape can be plated in one process, and that electro-tinning is particularly useful for articles with soldered joints, which would disintegrate at the temperatures used in hot-tinning.

The protective film for tinplate, recently evolved in the Institute's Laboratories, has undergone further tests with encouraging results. A description of the process is illustrated by photographs of treated and untreated cans which have been used for meat, soup and peas. The untreated cans show considerable staining, but the treated cans appear as bright as when originally packed.

A new method for tinning copper or brass by a simple chemical process is also described in this issue, and commercial uses for the process are suggested. There are also articles on Tinned Piston Rings, and on the use of solder for correcting faults and producing smooth contours in all-steel automobile bodies. More examples of the Institute's free technical service are given, and special attention is drawn to the importance of research organisations to industry in war conditions.